FACT SHEET

United States Environmental Protection Agency (EPA)
Region 10
Park Place Building, 13th Floor
1200 Sixth Avenue, OW-130
Seattle, Washington 98101
(206) 553-1214

Date:

Permit No.: ID-002150-4

PROPOSED REISSUANCE OF A NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES) PERMIT TO DISCHARGE POLLUTANTS AND TO LAND APPLY SEWAGE SLUDGE (BIOSOLIDS) PURSUANT TO THE PROVISIONS OF THE CLEAN WATER ACT (CWA)

CITY OF CALDWELL

has applied for reissuance of a NPDES permit to discharge pollutants and land apply biosolids pursuant to the provisions of the CWA. This Fact Sheet includes (a) the tentative determination of the EPA to reissue the permit, (b) information on public comment, public hearing and appeal procedures, (c) the description of the current discharge and biosolids practices, (d) a listing of tentative effluent limitations, schedules of compliance and other conditions, and (e) a sketch or description of the discharge location and biosolids land application areas. We call your special attention to the technical material presented in the latter part of this document.

Persons wishing to comment on the tentative determinations contained in the proposed permit reissuance may do so by the expiration date of the Public Notice. All written comments should be submitted to EPA as described in the Public Comments Section of the attached Public Notice.

After the expiration date of the Public Notice, the Director, Office of Water, will make final determinations with respect to the permit reissuance. The tentative determinations contained in the draft permit will become final conditions if no substantive comments are received during the public notice period.

The permit will become effective 30 days after the final determinations are made, unless a request for an evidentiary hearing is submitted within 30 days after receipt of the final determinations.

The proposed NPDES permit and other related documents are on file and may be inspected at the above address any time between 8:30 a.m. and 4:00 p.m., Monday through Friday. Copies and other information may be requested by writing to EPA at the above address to the attention of the NPDES Permits Unit, or by calling (206) 553-1214. This material is also available from the EPA Idaho Operations Office, 1435 N. Orchard Street, Boise, Idaho 83706.

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TECHNICAL INFORMATION

I. Applicant

City of Caldwell
621 Cleveland Blvd.
Caldwell, Idaho 83605

NPDES Permit No.: ID-002150-4
Facility contact: Gordon Law, City Engineer
(208) 455-3009

II. Activity

The City of Caldwell owns and operates a wastewater treatment plant that treats domestic sewage. The facility provides secondary treatment of wastewater prior to discharging it to the Boise River. The facility is in the final design stage for Phase 1 and Phase 2 upgrades that will allow the treatment of an average monthly flow of 8.48 million gallons per day (mgd). The existing facility is designed for an average annual flow of 7.78mgd. Currently, the average annual monthly flow is approximately 5.75 MGD.

A fact sheet and draft NPDES permit were public noticed for this facility on December 27, 1993. However, a final permit was never issued. Since 1993, changes in the state water quality standards have occurred. Therefore, a new fact sheet and draft NPDES permit have been developed which include the latest regulations.

III. Receiving Water

A. Outfall location: The City of Caldwell wastewater treatment plant discharges its wastewater to the Boise River via outfall 001. Outfall 001 is located at latitude 43° 41' 43" and longitude 116° 41' 19".

B. Water Quality Standards: Water Quality standards are composed of use classifications, and numeric and/or narrative water quality criteria.

The first part of a State's water quality standard is a classification system for water bodies based on the expected beneficial uses of those water bodies. The Idaho *Water Quality Standards and Wastewater Treatment Requirements* (IDAPA 16.01.02.140.01.x.) protect the Boise River from Caldwell to its mouth for the following use classifications: cold water biota, primary contact recreation, secondary contact recreation and agricultural water supply.

The second part of the State's water quality standards is the water quality criteria deemed necessary to support the beneficial use classification of each water body. These criteria may be numeric or narrative.

The criteria that are necessary to protect cold water biota are found in:

- 40 CFR §131.36 (b)(1), columns B1, B2, and D2 (with the exception of the human health arsenic criteria),
- The human health criteria for arsenic is found in Idaho's *Water Quality Standards and Wastewater Treatment Requirements* at IDAPA 16.01.02.250.02.a.iv.
- Idaho's *Water Quality Standards and Wastewater Treatment Requirements* at IDAPA 16.01.02.200.,16.01.02.250.02.a., and 16.01.02.250.02.c.

The criteria necessary to protect primary contact recration are found in:
- Idaho's *Water Quality Standards and Wastewater Treatment Requirements* at IDAPA 16.01.02.200., 16.01.02.250.01.a;
- 40 CFR §131.36(b)(1), column D2 (with the exception of the human health criteria for arsenic);
- The human health criteria for arsenic is found in Idaho's *Water Quality Standards and Wastewater Treatment Requirements* at IDAPA 16.01.02.250.01.c.

The criteria necessary to protect secondary contact recreation are found in:
- Idaho's *Water Quality Standards and Wastewater Treatment Requirements* at IDAPA 16.01.02.200., 16.01.02.250.01.b;
- 40 CFR §131.36(b)(1), column D2 (with the exception of the human health criteria for arsenic);
- The human health criteria for arsenic is found in Idaho's *Water Quality Standards and Wastewater Treatment Requirements* at IDAPA 16.01.02.250.01.c.

The criteria necessary to protect for agricultural use is found in:
- Idaho's *Water Quality Standards and Wastewater Treatment Requirements* at IDAPA 16.01.02.200., and 16.01.02.250.03.b.

A summary of the water quality criteria applicable to the Boise River is listed in Appendix A.

C. Boise River Flows: Flows in the Boise River are controlled by Lucky Peak Dam, approximately 40 miles upstream from the Caldwell discharge. Between Lucky Peak and its confluence with the Snake River, the Boise River is regulated to provide irrigation water for farming and to control flooding in the Boise valley. This regulation results in three flow "seasons" in the river: March through June (high); July through October (irrigation); and November through February (low). The following are low flows applicable to the Boise River at Caldwell for each "season":

	High Flow	Irrigation Flow	Winter Flow
1Q10	76 cfs	126 cfs	115 cfs
7Q10	303 cfs	325 cfs	124 cfs
30Q5	333 cfs	357 cfs	136 cfs
Harmonic Mean	909 cfs	975 cfs	372 cfs

D. Water Quality Limited Segment: A water quality limited segment is any waterbody, or definable portion of water body, where it is known that water quality does not meet applicable water quality standrds, and/or is not expected to meet applicable water quality standards. The reach of the Boise River that accepts Caldwell's discharge has been formally listed as water quality limited for sediments, fecal coliform, nutrients and temperature.

Section 303(d) of the Clean Water Act (CWA) requires States to develop a Total Maximum Daily Load (TMDL) management plan for water bodies determined to be water quality limited. A TMDL documents the amount of a pollutant a waterbody can assimilate without violating a State's water quality standards and allocates that load capacity to known point sources and nonpiont sources. A TMDL for Lower Boise River is scheduled to be completed in 1998. A condition has been included in the proposed permit which will allows the permit to be modified to incorporate the TMDL when it is completed.

IV. Description of Facility and Discharge

Caldwell is currently in the final design stage of Phase 1 improvements, with construction scheduled to begin in July 1998. Phase 2 is scheduled to be designed in 1999 and constructed in 2000.

The existing wastewater treatment plant treats wastewater by screening and grit removal, solids removal in one primary clarifier, soluble organic removal in one trickling filter, one biotower, and one secondary clarifier (a third clarifier can be used as either a primary or a secondary clarifier); final solids removal in two shallow sand filters, and chlorine disinfection with chlorine before discharge to the Boise River. The solids removed during the treatment process are digested in three anaerobic digesters and are stored and thickened in a sludge storage lagoon; The facility produces Class B biosolids which are usually applied to the land, in Canyon County, in liquid form with sludge trucks. Detailed records are kept of biosolids applications. The existing raw sewage pump station is currently being upgraded with higher capacity pumps.

The Phase 1 improvements will include a new intermediate pump station to lift wastewater for gravity flow through the new and future facilities; an organic treatment and nitrification system comprised of a new selector basin, two aeration basins with fine bubble aeration blowers, two final clarifiers, and associated pumps; thickening of the waste solids and pumping to the existing digesters; improvements of the existing digester no. 2; a new operations building; associated yard piping, a new electrical system with larger emergency power generator; and a new central computerized monitoring system for the new facilities only. The existing shallow sand filters will be demolished. The rest of the existing plant will continue to be operated. Two of the existing clarifiers will be operated as primary clarifiers. Based on capacity, approximately half of the primary effluent will be treated in the trickling filter, biotower, and secondary clarifier. This secondary effluent will be combined with the other half of the primary effluent before pumping into the selector basin/aeration basin for final treatment. As currently planned, the upgraded facility will be able to nitrify or provide biological phosphorus removal, but will not have the capability of performing both functions at the same time.

The Phase 2 improvements will include new mechanisms and groundwater protection for the oldest two clarifiers and conversion of the effluent disinfection system from chlorine to ultraviolet light.

The Phase 1 and Phase 2 facilities (except the aeration basin) are being designed for the flows and loads estimated for the year 2015. A third aeration basin may be required by the year 2002, and other facilities as discussed in the city's Facilities Plan will be required between the years 2002 and 2015. Some of the existing facilities may not have sufficient capacity for the 2015 flows.

The city anticipates that the Phase 1 and Phase 2 facilities will produce an effluent that meets current criteria for municipal facilities with the possible exception of dissolved oxygen. If the dissolved oxygen criteria cannot be met through the treatment process, supplemental post-aeration basins are scheduled to be constructed in the year 2002.

The upgraded wastewater treatment plant has a design flow of 8.48 MGD (13 cfs), design nitrogen removal of 85%, 5-day biological oxidation demand (BOD_5) and total suspended solids (TSS) removal rates of 85%.

A review of the discharge monitoring reports (DMRs) from 1991 through 1997 shows the facility has been in compliance with the requirements of its current NPDES permit limits.

V. <u>Basis for Permit Conditions</u>

A. General Approach

Sections 101, 301(b), 304, 308, 401, 402 and 405 of the Clean Water Act (CWA) provide the basis for the effluent limitations and other conditions in the draft permit. EPA evaluates discharges with respect to these sections of the CWA and the relevant NPDES regulations in determining which conditions to include in the permit.

The CWA requires Publicly Owned Treatment Works (POTWs) to meet performance-based requirements based on available wastewater treatment technology. Section 301 of the CWA established a required performance level, referred to as "secondary treatment," that all POTWs were required to meet by July 1, 1977. EPA developed secondary treatment regulations which are specified in 40 CFR §133. These technology-based limits apply to all municipal wastewater treatment plants and identify the minimum level of effluent quality attainable by secondary treatment in terms of BOD, TSS, and pH.

EPA may find, by analyzing the effect of a discharge on the receiving water, that technology based permit limits are not sufficiently stringent to meet water quality standards. In such cases, EPA regulations at 40 CFR §122.44(d)(1) require the development of more stringent, water quality-based limits (WQBELs) designed to ensure that water quality standards are met. The proposed permit limits reflect whichever limits (technology-based or water quality-based) are most stringent.

Under Section 308 of the CWA and 40 CFR §122.44(i), EPA must include monitoring requirements in the permit to determine compliance with effluent limitations. Effluent and ambient monitoring may also be required to gather data for future effluent limitations or to monitor effluent impacts on receiving water quality. Monitoring frequencies are based on the nature and effect of the pollutant, as well as a determination of the minimum sampling necessary to adequately monitor the facility's performance.

B. Technology-Based Evaluation

1. $\underline{BOD_5 \text{ and TSS Concentration Limitations}}$: Secondary treatment standards are defined in the federal regulations at 40 CFR §133.102 (state regulations at IDAPA 16.01.02.420) as follows:

Parameter	Monthly Average	Weekly Average	Percent Removal
Biochemical Oxygen Demand (BOD_5)	30 mg/L	45 mg/L	85%
Total Suspended Solids (TSS)	30 mg/L	45 mg/L	85%

These effluent limitations are in the current permit and will be retained in the draft permit.

2. $\underline{BOD_5 \text{ and TSS Loading Limitations}}$: In accordance with federal regulations (40 CFR § 122.45 (f)), the secondary treatment requirements must be expressed as mass based limits using the design flow of the facility. However, the discharge is to a high priority, §303(d) listed segment of the Boise River that is listed for sediment and nutrients, and is subject to IDAPA 16.01.02.054.04, the "no net increase" provision at least for TSS.

3. pH: The technology-based pH limitation for POTWs is defined in the federal regulations 40 CFR §133.102. The pH of the effluent is required to be within the range of 6.0 to 9.0 standard units.

4. <u>Fecal coliform bacteria</u>: The technology-based fecal coliform bacteria limitation for POTWs is defined in Idaho's water quality standards (IDAPA 16.01.02.420.05). Fecal coliform concentrations in secondary treated effluent must not exceed a geometric mean of 200/100 ml based on no more than one week's data and a minimum of five samples.

5. <u>Total Residual Chlorine</u>: The technology-based effluent limitation of 0.5 mg/l is derived from standard operating practices. The Water Pollution Control Federation's <u>Chlorination of Wastewater</u> (1976) states that a properly designed and maintained wastewater treatment plant can achieve adequate disinfection if a 0.5 mg/l chlorine residual is maintained after 15 minutes of contact time. A treatment plant that provides adequate chlorination contact time can meet the 0.5 mg/l limit on a monthly average basis.

C. Water Quality-Based Evaluation

1. Statutory Basis for Water Quality-Based Limits

Section 301(b)(1)(C) of the CWA requires the development of limitations in permits necessary to meet water quality standards by July 1, 1977. Discharges to state waters must also comply with limitations imposed by the state as part of its certification of NPDES permits under section 401 of the CWA.

The NPDES regulation (40 CFR § 122.44(d)(1)) implementing section 301 (b)(1)(C) of the CWA requires that permits include limits for all pollutants or parameters which "are or may be discharged at a level which will cause, have the reasonable potential to cause , or contribute to an excursion above any state water quality standard, including state narrative criteria for water quality."

The regulations require that this evaluation be made using procedures which account for existing controls on point and nonpoint sources of pollution, the variability of the pollutant in the effluent, species sensitivity (for toxicity), and where appropriate, dilution in the receiving water. The limits must be stringent enough to ensure that water quality standards are met, and must be consistent with any available wasteload allocation.

The regulations also address when whole effluent toxicity (WET) and chemical-specific limits are required. A WET limit is required whenever the toxicity of the effluent has the reasonable potential to cause or contribute to an excursion above either a numeric or narrative standard for toxicity. The only exception is where chemical-specific limits will fully achieve the narrative standard. A chemical-specific limit is required whenever an individual pollutant is at a level of concern (as defined at 40 CFR 122.44(d)(1)) relative to the numeric standard for that pollutant.

2. Reasonable Potential Determination

When evaluating the effluent to determine if water quality based effluent limits (WQBELs) are needed based on chemical specific numeric criteria, a projection of the receiving water concentration (downstream of where the effluent enters the receiving water) for each pollutant of concern is made. If the projected concentration of the receiving water exceeds the applicable numeric criterion for a specific chemical, then there is a reasonable potential that the discharge may cause or contribute to an excursion above the applicable water quality standards, and a WQBEL is required.

The effluent limits in the current permit for pH, fecal coliform bacteria, ammonia, DO, temperature, and total residual chlorine were compared with water quality standards to determine whether more stringent limits were necessary to ensure compliance with water quality standards. Additionally, the level of metals and whole effluent toxicity discharged by the wastewater treatment facility were compared with water quality standards to determine if effluent limits needed to be incorporated into the proposed permit to ensure compliance with water quality standards.

3. Derivation of Water Quality Based Effluent Limit

In deriving the WQBELs, Region 10 applies the statistical permit limit derivation approach described in chapter 5 the *Technical Support Document for Water Quality-Based Toxics Control* (TSD). This approach takes into account effluent variability, sampling frequency, and the difference in time frames between the water quality standards and monthly average and daily maximum limits. In addition to the numeric water quality criteria and dilution values, EPA used the following values in deriving limits, using the formulas in the TSD:

Probability value for long-term average calculation	99%
Probability value for monthly average limit calculation	95%
Probability value for daily maximum limit calculation	99%
Coefficient of variation for parameters of concern	Variable, see Appendix B
Frequency of monitoring for parameters of concern	Variable, see Appendix C

The limits which EPA is proposing in the draft permit for each parameter are discussed below.

(a) pH

The state water quality standard for pH is 6.5 - 9.5 standard units for the protection of aquatic life (IDAPA 16.01.02.250.02.i.). In the proposed permit, the effluent is required to be between 6.5 - 9.0 standard units. The lower end of the range reflects the state's requirement for the protection of water quality standards. The upper end of the range reflects the federal technology based requirement of 9.0 standard units (see Part V.B.3. of the fact sheet).

(b) Fecal Coliform Bacteria

The current permit has a monthly limit of 50 colonies/100 ml and a weekly limit of 100 colonies/100 ml year round. The state water quality standards limit fecal coliform bacteria for waters protected for primary contact recreation between May 1 and September 30. Waters are not to contain fecal coliform bacteria in concentrations exceeding 500/100 ml at any time, or a geometric mean of 50/100 ml based on a minimum of 5 samples taken over a thirty day period (IDAPA 16.01.02.250.01.a.). As discussed previously, the technology-based requirement for fecal coliform bacteria states that the effluent must not exceed a weekly geometric mean of 200/100 ml based on one weeks data and a minimum of five samples.

To comply with Idaho water quality standards a maximum daily limit of 500/100 ml, and an average monthly limit of 50/100 ml will also be incorporated into the proposed permit between May 1 and September 30.

The state water quality standards limit fecal coliform bacteria for waters protected for secondary contact recreation. Waters are not to contain fecal coliform bacteria in concentrations exceeding 800/100 ml at any time, and a geometric mean of 200/100 ml based on a minimum of 5 samples taken over a thirty day period (IDAPA 16.01.02.250.01.b.). As discussed previously, the technology-based requirement for fecal coliform bacteria states that the effluent must not exceed a weekly geometric mean of 200/100 ml based on one weeks data and a minimum of five samples.

The proposed permit incorporates the weekly fecal coliform bacteria limit of 200/100 ml (technology-based). To comply with Idaho water quality standards a maximum daily limit of 800/100 ml, and an average monthly limit of 200/100 ml will also be incorporated into the proposed permit. These limits will apply between October 1 and April 30.

The State of Idaho is contemplating changing the criteria for contact recreation. Consequently, the State has recommended that the effluent be monitored for E.Coli bacteria. The draft permit will require once-per-month monitoring for E.Coli bacteria.

(c) Dissolved Oxygen/Biochemical Oxygen Demand (BOD)

Dissolved Oxygen: The state water quality standards requires the level of D.O. to exceed 6 mg/L at all times for water bodies that are protected for aquatic life use. For waters protected for salmonid spawning, the criteria are a one-day minimum of not less than 6.0 mg/L or 90% of saturation, whichever is greater.

Caldwell has monitored effluent DO concentrations on a daily basis since January 1995. In-stream data indicates the Boise River approaches the DO water quality standard upstream of the facility, with values ranging from 6.6 to 13.9 mg/L. The Streeter-Phelps DO model was run in an attempt to determine the impact of the Caldwell discharge on in-stream DO concentrations.

The model was first run using worst-case assumptions for background DO, stream flow BOD loading, stream dimensions, temperature, and effluent DO. The model was run a second time to determine the effect on the river if Caldwell's discharge were eliminated completely (Appendix F).

Based on the results of this modeling exercise, with worst-case conditions, it appears that Caldwell's discharge neither supresses nor increases DO levels in the Boise River at the proposed design flow of 13 cfs. The proposed permit includes DO limits of 6.0 mg/L.

Biochemical Oxygen Demand: BOD is a measure of the amount of oxygen required to stabilize organic matter in wastewater. It measures the total concentration of dissolved oxygen that would eventually be demanded as wastewater degrades in the stream. Therefore, the BOD loading from the wastewater treatment facility may impact downstream DO levels. Based on the results of the Streeter-Phelps modeling, using worst-case conditions, it does not appear that Caldwell's BOD load at the upgraded design capacity of 13 cfs will adversely impact the Boise River. The proposed permit includes loading limitations for BOD of 2122 lbs/day monthly average and 3183 lbs/day weekly average.

(d) Total Residual Chlorine

The current permit has a maximum daily residual chlorine limit of 2.0 mg/L. A reasonable potential analysis indicates that the current discharge has the potential to violate the state water quality standards (see Appendix B). Water quality based effluent limits for chlorine are:

	High	Irrigation	Low
Monthly Average, µg/L (lbs/day)	17.9(1.3)	25.0(1.8)	19.0(1.3)
Maximum Daily, µg/L (lbs/day)	40.2(2.8)	56.3(4.0)	43.0(3.1)

For additional information on developing the effluent limitation see Appendix C.

As part of the wastewater treatment plant upgrade, ultra-violet (UV) disinfection will replace the existing chlorination system. The UV system is scheduled to be on-line by January 1, 2001. In effect, the city will comply with the WQBELs for chlorine by eliminating the system. The proposed permit includes an interim residual chlorine limit of 0.5 mg/L (technology-based limit) which will apply until the chlorine system is removed. The proposed permit does not allow a chlorine discharge after January 1, 2001.

(e) Total Ammonia

The existing Caldwell permit does not include total ammonia effluent limitations, nor has the city done any voluntary sampling for ammonia in its effluent. Data collected by the state Division of Environmental Quality as part of their annual permit compliance inspections over the past 10 years were used to evaluate the need for WQBELs in the proposed permit.

A reasonable potential analysis was conducted by EPA to ensure that the existing effluent level of ammonia does not violate the state's water quality standards. The following assumptions were used:

PARAMETER	HIGH	IRRIGATION	LOW
pH, standard units	8.1	8.0	8.1
Temperature. °C	16	20	8
1Q10, cfs	76	126	115
7Q10, cfs	303	325	124
acute criterion, mg/L (total ammonia)	1.3	5.63	4.9
chronia criterion, mg/L (total ammonia)	0.29	0.93	1.13
allow a 25% mixing zone			
Caldwell design flow = 13 cfs			
Background concentration, mg/l	0.11	0.11	0.3

Using these assumptions it was found that discharging at current levels would violate the acute and chronic criteria (see Appendix B). Therefore, the WQBELs were calculated. Average monthly and daily maximum limits will be incorporated into the proposed permit (see Appendix C).

(f) Arsenic and Metals

The metals of concern in the effluent are arsenic, cadmium, chromium, copper, lead, mercury, nickel, and zinc. The reasonable potential calculation for each of these parameters indicates a WQBEL is not required at this time.

While the reasonable potential calculation indicated that WQBELs were not required, this determination was made using the assumption that the ambient background levels of these pollutants were zero. This is significant because as the ambient level of a pollutant increases the chance that the effluent will cause an exceedance of the water quality standard will also increase. Ambient monitoring will be included in the proposed permit and this information will be used in the reasonable potential calculation during the next permitting cycle to determine if WQBELs are needed.

(g) Whole Effluent Toxicity/No Toxics Substances in Concentrations that Impair Designated Uses

The state water quality standards require surface waters of the State to be free from toxic substances in concentrations that impair use classifications. Data do not exist to support the development of a WET limit at this time. The proposed permit will require the permittee to monitor for whole effluent toxicity, and this information will be used in the next permitting cycle to determine if a WET limit is required.

(h) Temperature

For cold water biota, the state water quality standards require water temperatures of twenty-two (22) degrees C or less with a maximum daily average of no greater than nineteen (19) degrees C. Salmonid spawning (Mountain White Fish) is an existing use in this reach of the Boise River (per DEQ/Id. Dept. of Fish & Game correspondence). Therefore the induced temperature variation must not exceed plus one degree C. Further, between October 15 and March 15, the ambient water temperature must not exceed 13 degrees C, with a maximum daily average no greater than 9 degrees C. Caldwell collected temperature data on the effluent during 1996. The data show there are some exceedences of the temperature standards at the end of pipe. Historic in-stream data upstream of the city also show some standards violations. Current downstream data are insufficient to determine if the daily average temperature requirements are being met. Therefore, temperature limits will not be included in the permit at this time. However, ambient and effluent monitoring for temperature will be included in the proposed permit. IDEQ has requested that weekly monitoring for temperature at the hottest part of the day be included in the proposed permit. Additionally, they have requested that once per month temperature be monitored hourly for a twenty-four hour period. These requirements have been incorporated into the proposed permit.

(i) Turbidity

The state water quality standards require that turbidity not exceed background turbidity by more than fifty (50) NTU instantaneously or more than twenty five (25) NTU for more than ten (10) consecutive days. Data do not exist to support the development of a turbidity limit at this time. The proposed permit will require the permittee to monitor for turbidity, and this information will be used in the next permitting cycle to determine if a limit is required.

(j) Floating, Suspended or Submerged Matter

The state water quality standards require surface waters of the State to be free from floating, suspended, or submerged matter of any kind in concentrations causing nuisance or objectionable conditions or that may impair designated beneficial uses. This requirement is a condition of the current permit and will be retained in the proposed permit.

(k) Nutrients

The state water quality standards require surface waters of the state to be free from excess nutrients that can cause visible slime growths or other nuisance aquatic growths impairing designated uses. The state is developing a “No Net Increase Total Phosphorus Load for the Lower Boise River Watershed” at this time. If the state includes the proposed loadings in it’s 401 certification of the permit, the limits will be included in the final permit. The proposed permit will require the permittee to monitor for nutrients, and to develop a study to determine if excess nutrients are impairing water quality. Additionally, IDEQ requested that nutrient monitoring be weekly upstream and downstream of the discharge. This information will be used in the next permitting cycle to determine if a limit is required.

The IDEQ also requested that provisions that allow Caldwell to use effluent trading, if they choose to participate, to meet new limits for phosphorus be included in the proposed permit. EPA is also interested in pursuing market-based incentives, such as effluent trading, to reduce nutrient loading in the Lower Boise River watershed. At this point, no trades have been established or proposed and, therefore are not reflected in the proposed permit. Should trades be established at a later date, EPA will work with the participating parties in order to facilitate trades and to establish appropriate mechanisms to incorporate the trades into the city’s permit.

(j) Total Suspended Solids

Federal regulations (40 CFR §122.45(f)) state that the secondary treatment requirements must be expressed as mass based limits using the design flow of the facility. However, the discharge is to a high priority, §303(d) listed segment of the Boise River that is listed for sediments and is thus subject to IDAPA 16.01.02.054.04, the "no net increase" provision. The IDEQ has suggested incorporating effluent limits for total suspended solids that equal Caldwell's 1996 load. If the state includes the no-net-increase loadings in its 401 certification, they will be incorporated into the final permit. In the absence of no-net-increase loadings, the loadings in the existing permit will be retained in the new permit.

The IDEQ also requested that provisions that allow Caldwell to use effluent trading, if they choose to participate, to meet new limits for total suspended solids be included in the proposed permit. EPA is also interested in pursuing market-based incentives, such as effluent trading, to reduce sediment loading in the Lower Boise River watershed. At this point, no trades have been established or proposed and, therefore are not reflected in the proposed permit. Should trades be established at a later date, EPA will work with the participating parties in order to facilitate trades and to establish appropriate mechanisms to incorporate the trades into the city's permit.

D. Compliance Schedule

The proposed permit requires the elimination of the chlorine system by January 1, 2001 to comply with the WQBELs for chlorine. Consistent with 40 CFR Part 122.47, the permittee will be required to submit annual reports which document progress toward reaching the final compliance level. In accordance with section 16.01.02.400.03 of the Idaho state water quality standards, discharge permits can incorporate compliance schedules which allow a discharger to phase in compliance with water quality-based effluent limits when new limits are in permits for the first time.

The annual report shall include an assessment of the previous year of chlorine data. The annual progress report shall be submitted with the January Discharge Monitoring Report (DMR). The first report is due with the January 1999 DMR and annually thereafter, until compliance with the effluent limits is achieved.

E. Pretreatment Program Requirements

During the winter, the non-domestic flow from the significant industrial users is approximately 7% of the average winter flow of 3 mgd. During the summer the significant industrial user contribution is approximately 3% of the 7 mgd flow. The significant industrial users are:

Darigold Creamery Association
Von-Ruse Enterprises

In August 1983, the City of Caldwell submitted a formal pretreatment program application that met the requirements of 40 CFR Part 403. The program was approved by EPA and incorporated into the city's NPDES permit effective September 26, 1984

The facility developed local limits as part of the pretreatment program in 1993. Its sewer use ordinance was revised to incorporate those local limits and changes required by 40 C.F.R. §403 and approved by EPA Region 10 on November 16, 1993. Additional pretreatment conditions in the proposed permit are essentially the same as in the current permit; they include semi-annual sampling of the influent, effluent, and final sludge; a pretreatment annual report; and program management requirements

The city's pretreatment program has been evaluated on an annual basis through on-site visits and review of the annual pretreatment reports. Program modifications have been submitted to EPA for review and approval.

F. Sludge (Biosolids) Management Requirements

1. General

The biosolids management regulations of 40 CFR §503 were designed so that the standards are directly enforceable against most users or disposers of biosolids, whether or not they obtain a permit. Therefore, the publication of Part 503 in the *Federal Register* on February 19, 1993 served as notice to the regulated community of its duty to comply with the requirements of the rule, except those requirements that indicate that the permitting authority shall specify what has to be done.

Even though Part 503 is largely self-implementing, Section 405(f) of the CWA requires the inclusion of biosolids use or disposal requirements in any NPDES permit issued to a Treatment Works Treating Domestic Sewage (TWTDS). In addition, the biosolids permitting regulations in 40 CFR §122 and §124 have been revised to expand its authority to issue NPDES permits with these requirements. This includes all biosolids generators, biosolids treaters and blenders, surface disposal sites and biosolids incinerators. Therefore, the requirements of 40 CFR §503 have to be met when biosolids is applied to the land, placed on a surface disposal site, placed on a municipal solid waste landfill (MSWLF) unit, or fired in a biosolids incinerator.

Requirements are included in Part 503 for pollutants in biosolids, the reduction of pathogens in biosolids, the reduction of the characteristics in biosolids that attract vectors, the quality of the exit gas from a biosolids incinerator stack, the quality of biosolids that is placed in a MSWLF unit, the sites where biosolids is either land applied or placed for final disposal, and for a biosolids incinerator. The sections of the federal standards at 40 CFR §503 applicable to this facility's proposed practices are Section A

(General Provisions, 503.1-9), Section B (Land Application, 503.10-18), and Section D (Pathogen & Vector Control, 503.30-33).

2. Biosolids Management

The permittee produces and distributes Class B biosolids for use on agricultural land in Canyon County. Class B biosolids is applied as a soil amendment product. The permittee has submitted, to EPA, land application plans for sites where biosolids are being applied as a fertilizer or soil amendment to land (see Appendix E).

For land application sites being used for the distribution of biosolids the proposed permit (1) defines the area where biosolids may be distributed, (2) establishes limitations for ten metals, (3) establishes pathogen reduction requirements, and (4) establishes vector control requirements.

3. Permit Requirements

To ensure compliance with the CWA and the federal standards for the use or disposal biosolids (40 CFR 503), the proposed permit contains the following requirements:

a. <u>State Laws and Future Federal Standards</u>: Pursuant to 40 CFR 122.41(a), a condition has been incorporated into the proposed permit requiring the Permittee to comply with all existing federal and state laws, and all regulations applying to biosolids use and disposal. These standards shall be interpreted using the proposed permit and the specific EPA guidance documents listed in paragraph b, below. These documents are used by EPA Region 10 as the primary technical references for both permitting and enforcement activities.

b. <u>Health and Environmental General Requirement:</u> The CWA requires that the environment and public health be protected from toxic effects of any pollutants in biosolids. Therefore, the Permittee must handle and use/dispose of biosolids in such a way as to protect human health and the environment. Under this requirement the permittee is responsible for being aware of all pollutants allowed to accumulate in the biosolids, and for preventing harm to the public from those pollutants.

The U.S. Department of Agriculture can assist the facility in evaluating potential nutrient or micronutrient problems. Additionally, EPA has published the following guidance to assist facilities in evaluating their biosolids for pollutants other than those listed in 40 CFR §503: *Part 503 Implementation Guidance,* EPA 833-R-95-001, and *Environmental Regulations and Technology:*

Control of Pathogens and Vector Attraction in Sewage Sludge, EPA/625/R-92/013.

c. Protection of Surface Waters from Biosolids Pollutants: Section 405(a) of the CWA prohibits any practice where biosolids pollutants removed in a treatment works at one location would ultimately enter surface waters at another location. Under this requirement the Permittee must protect surface waters from metals, nutrients, and pathogens contained in the biosolids.

d. Responsibility for Land Application: 40 CFR §503.7 of the biosolids regulations specify that generators are responsible for correct use or disposal of their biosolids. For purposes of this permit and for purposes of compliance with the 40 CFR §503 regulations, the permittee is considered the "person who applies sewage sludge to the land" under the land application regulations. All haulers, contractors, farmers, or others who might be involved in the land application process or in post-application control of the land and the crops are considered agents for the permittee, for determination of compliance with the permit and for determination of compliance with the 40 CFR §503 regulations (which are self-implementing).

e. Control of Pathogens, Vectors, and Metals: The regulations allow alternative methods and measurements for preparing Class B biosolids. The proposed permit establishes basic standards that the biosolids must meet for metals, pathogens, and vector control. Additionally, the proposed permit allows the Permittee to use alternative standards which are available under the regulations. The permittee must submit written notice to EPA 90 days in advance of using an alternative standard.

f. Biosolids Use/Disposal Practices: The permit application indicates the facility land applies its biosolids; therefore, this practice is authorized in the proposed permit. For authorized land application sites see Appendix E.

The application indicates that the facility does not receive biosolids from other treatment works, or dispose of its biosolids in a municpal solid waste landfill, therefore the permit prohibits these activities.

g. Crop Trials: Optimum loading rates, application methods, crop responses, environmental impacts, cost-effectiveness, and other agricultural practices may vary with different crops and from site to site when using biosolids as a soil amendment. Applying biosolids to areas of land two acres or less facilitates the development of appropriate agricultural practices when using biosolids as a soil amendment.

The permit authorizes the distribution of biosolids on areas of land two acres or less for the purpose of optimizing agricultural practices. The land used for crop trials does not need to be within the authorized land application sites (see Appendix E for land application sites).

The permittee must notify the Environmental Protection Agency, Idaho Operations Office, the Idaho Division of Environmental Quality, Southwest Idaho Regional Office, and the Natural Resources Conservation Service of the U.S. Department of Agriculture nearest the area of the site when distributing biosolids for crop trials outside the authorized land application sites.

h. Reporting: At a minimum, 40 CFR 503.18 specifies that certain facilities report annually the information that they are required to develop and retain under the record keeping requirements (40 CFR 503.17). This requirement applies to permittee defined as Class I management facilities, POTWs with a flow rate equal to or greater than one mgd, and POTWs serving a population of 10,000 or greater. The following information should be included to improve the reliability of the report: (1) units for reported concentrations, (2) dry weight concentrations, (3) number of samples collected during the monitoring period, (4) number of excursions during the monitoring period, (5) sample collection techniques, and (6) analytical methods.

i. Sludge digesters are vulnerable to breakdown, periods of poor performance, or needing periodic cleaning. Additionally, use of a land application site is subject to sudden changes in owner cooperation or crop selection, extended or inconvienient adverse weather, substitution of other fertilizers, loss of regulator approval or permit, and citizen complaints. Therefore, development and implementation of a contingency plan is necessary to maintain compliance with 40 CFR §503 in the event that there are mechanical problems with sludge digesters, and/or land application sites are temporarily unavailable.

G. Monitoring Requirements

The following monitoring requirements have been included in the permit pursuant to section 308 of the CWA and 40 CFR §122.44(I). Monitoring frequencies are based on the nature and effect of the pollutants, as well as a determination of the minimum sampling necessary to adequately monitor the facility's performance.

1. Influent and Effluent Monitoring: The proposed permit requires monitoring for the following parameters.

Parameter	Sample Location	Sample Frequency	Sample Type
Flow, mgd	Effluent	Continuous	Recording
BOD_5, mg/L	Influent and Effluent	1/week	24 hour composite
TSS, mg/L	Influent and Effluent	1/week	24 hour composite
Fecal Coliform Bacteria, colonies/100 ml	Effluent	5/week	grab
E.Coli Bacteria	Effluent	1/month	grab
Total Residual Chlorine, mg/L	Effluent	5/week	grab
pH, standard units	Effluent	5/week	grab
Ammonia as N, mg/L	Effluent	1/week	24 hour composite
Total Kjeldahl Nitrogen[1], mg/L	Effluent	1/week	24 hour composite
Nitrate-Nitrite as N[1], mg/L	1/month	1/week	24 hour composite
Dissolved Oxygen[1], mg/L	Effluent	1/week	grab
Temperature, °C[2]	Effluent	5/week	grab
Total Phosphorus[1], mg/L	Effluent	1/week	24 hour composite
Ortho-phosphate[1], mg/L	Effluent	1/week	24 hour composite
Turbidity[1], NTU	Effluent	1/week	24 hour composite
Hardness as $CACO_3$, mg/L	Effluent	1/month	24 hour composite
Arsenic[1], µg/L	Effluent	1/month	24 hour composite
Cadmium[1], µg/L	Effluent	1/month	24 hour composite
Chromium, µg/L	Effluent	1/month	24 hour composite
Copper[1], µg/L	Effluent	1/month	24 hour composite
Cyanide[1], µg/L	Effluent	1/month	24 hour composite

...CONTINUED ON NEXT PAGE...

Parameter	Sample Location	Sample Frequency	Sample Type
Lead[1], µg/L	Effluent	1/month	24 hour composite
Mercury[1] µg/L	Effluent	1/month	24 hour composite
Nickel[1], µg/L	Effluent	1/month	24 hour composite
Silver[1], µg/L	Effluent	1/month	24 hour composite
Zinc[1], µg/L	Effluent	1/month	24 hour composite
WET, TU_c	Effluent	2/year	24 hour composite

1. These parameters shall be analyzed for a period of two years, starting 90 days from the effective date of the permit. Arsenic, cadmium, copper, chromium, lead, and zinc shall be monitored as the total recoverable. Mercury shall be monitored as total.
2. Temperature shall be taken during the hottest part of the day.

2. Ambient Monitoring

The permittee shall implement a receiving water monitoring program. The data collected will be used in the next permitting cycle to ensure water quality standards are being achieved. The receiving water monitoring shall start 90 days from the effective date of the permit and last for a period of two years. The following parameters shall be sampled:

Parameter	Upstream Monitoring	Downstream Monitoring
Flow, mgd, weekly	Instantaneous	N/A
BOD_5, mg/L, weekly	Grab	N/A
TSS, mg/L, weekly	Grab	N/A
Fecal Coliform Bacteria, colonies/100 ml, weekly	Grab	N/A
E.Coli Bacteria, monthly	Grab	N/A
Dissolved Oxygen, mg/L, weekly	Grab	Grab
Total Phosphorus, mg/L, weekly	Grab	Grab
Ortho-phosphate, mg/L, weekly	Grab	Grab
Total Ammonia as N, mg/L, weekly	Grab	Grab
...CONTINUED ON NEXT PAGE...		

Parameter	Upstream Monitoring	Downstream Monitoring
Total Kjeldahl Nitrogen, mg/L, weekly	Grab	Grab
Nitrate-Nitrite as N, mg/L, weekly	Grab	Grab
Temperature, °C, weekly*	Grab	Grab
pH, standard units, weekly	Grab	Grab
Hardness, mg/L as $CaCO_3$, monthly	Grab	Grab
Turbidity, NTU, weekly	Grab	Grab
Arsenic, µg/L, dissolved, monthly	Grab	N/A
Cadmium, µg/L, dissolved, monthly	Grab	N/A
Chromium, µg/L, monthly	Grab	N/A
Copper, µg/L, dissolved, monthly	Grab	N/A
Cyanide, µg/L, dissolved, monthly	Grab	NA
Lead, µg/L, dissolved, monthly	Grab	N/A
Mercury, µg/L, total, monthly	Grab	N/A
Nickel, µg/L, dissolved, monthly	Grab	N/A
Silver, µg/L, dissolved, monthly	Grab	N/A
Zinc, µg/L, dissolved, monthly	Grab	N/A

1. Arsenic, cadmium, copper, chromium, lead, and zinc shall be monitored as total recoverable. Mercury shall be monitored as total.
2. Temperature shall be taken during the hottest part of the day.

3. <u>Temperature Monitoring</u>: To evaluate daily average temperature conditions, the permittee is required to monitoring temperature hourly for a twenty-four-hour period. Monitoring shall occur once per month at the effluent, the upstream monitoring location and the downstream monitoring location.

4. Method Detection Limits

   During the next permitting cycle the need for incorporating water quality based effluent limits into the permit will be re-evaluated. In order to assess if the water quality of the Boise River is being impacted by the effluent from Caldwell, it is necessary to use analytical methods that have method detection limits below the water quality criteria. Therefore, the permittee will be required to achieve the following:

Parameter	Method Detection Limit
Arsenic	2 µg/L
Cadmium	.5 µg/L
Chromium	2 µg/L
Copper	5 µg/L
Lead	1 µg/L
Mercury	.2 µg/L
Nickel	5 µg/L
Zinc	5 µg/L
Total residual chlorine	10 µg/L

H. Quality Assurance Plan

Under 40 CFR §122.41(e), the permittee must properly operate and maintain all facilities which it uses to achieve compliance with the conditions of the permit. This regulation also requires the permittee to ensure adequate laboratory controls and appropriate quality assurance procedures, and analytical methods. Quality assurance requirements apply to all monitoring requirements in the proposed permit including sample collection, handling, and shipment, on-site continuous and daily measurements, laboratory analysis, and data reporting and storage.

The draft permit requires the permittee to submit a quality assurance project plan to EPA within 90 days of the effective date of the permit. The plan is intended to address sampling techniques, sample preservation and shipment procedures, instrument calibration and preventive maintenance procedures, and personnel qualifications and training.

VI. Antidegradation

The Boise River at the Caldwell point of discharge is a Tier I waterbody. In proposing to reissue this permit, EPA has considered Idaho's antidegradation policy (IDAPA 16.01.02.051.01). This provision states that "the existing instream water uses and the level of water quality necessary to protect the existing uses shall be maintained and protected." The proposed permit includes the following loadings :

	Monthly Average	Weekly Average
BOD	2122	3183
TSS	1125	1690

The existing permit includes the following loadings:

BOD	1575	2365
TSS	1125	1690

The increases for BOD are based on a 2015 average monthly design flow of 8.48 mgd. Modeling indicates the increased BOD load will not result in a DO sag below the city's discharge point. DEQ has determined that increasing the TSS load to the new design level could result in water quality violations. If interim no-net-increase loadings are included in the 401 certification from DEQ, they will be included in the final permit.

VII. Other Legal Requirements

A. Endangered Species Act

Section 7 of the Endangered Species Act (ESA) requires federal agencies to request a consultation with the National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service (USF&WS) regarding potential effects an action may have on listed endangered species.In a letter dated October 24, 1997, the U.S. Fish and Wildlife Service identified the peregrin falcon as being a federally-listed endangered species. There are no proposed or candidate species in the area of the discharge.

In a letter dated October 21, 1997, the National Oceanic and Atmospheric Administration, National Marine Fisheries Service stated that the proposed discharge from the wastewater treatment plant is not within the designated critical habitat for listed Snake River Salmon, and critical habitat has not yet been designated for Snake River steelhead. There are no threatened species in the area of the discharge.

It is not likely that the proposed permit will affect the peregrin falcon, Snake River salmon or Snake River steelhead. EPA will provide NMFS and USF&WS with copies of the proposed permit and fact sheet during the public notice period. Any comments received from these agencies regarding this determination will be considered prior to reissuance of this permit.

B. State Certification

Because state waters are involved in this permitting action, the provisions of Section 401 of the CWA apply. In accordance with 40 CFR §124.10(c)(1), public notice of the draft permit has been provided to the State of Idaho agencies having jurisdiction over fish, shellfish, and wildlife resources.

As part of the certification, the State will be asked to certify the mixing zone used in calculating the effluent limitations in the proposed permit. If certification of the mixing zone is not provided, the limitations in the permit will be recalculated based on meeting water quality standards at the point of discharge.

C. Length of Permit

This permit shall expire five years from the effective date of the permit.

APPENDIX A

Criteria Applicable To The Boise River At Caldwell

Criteria for the protection of cold water biota:

1.

Parameter	Aquactic Life Criteria[1]		Human Health Criteria[2]
	Acute criteria	Chronic criteria	
Arsenic (µg/L)	360	190	50
Cadmium[3] (µg/L)	3.70	1.03	NA
Chromium[3] (µg/L)	565	190	NA
Copper[3] (µg/L)	20	11	NA
Lead[3] (µg/L)	65	2.5	NA
Nickel[3] (µg/L)	1410	156	4600
Zinc[3] (µg/L)	115	104	NA
Silver (µg/L)	3.42	NA	NA
Mercury[4] (µg/L)	2.1	0.012	0.15
Chlorine (µg/L)	19	11	NA
Ammonia[5] (mg/L)			
Mar-Jun	1.3	0.29	NA
Jul-Oct	5.63	0.93	NA
Nov-Feb	4.9	1.13	NA

1. The acute and chronic aquatic life criteria for arsenic, cadmium, chromium, copper, lead, nickel, and zinc are expressed as the dissolved.
2. The human health criteria are expressed as the total recoverable.
3. The aquatic life criteria for cadmium, chromium, copper, lead, nickel, and zinc are hardness dependent. The 5th percentile ambient hardness value was used to calculate the criteria.
4. The acute aquatic life criterion for mercury is expressed as dissolved, and the chronic aquatic life criterion is expressed as total recoverable.
5. The ammonia criteria are from the Idaho Water Quality Standards at IDAPA 16.01.02.250.02.c.iii Tables III and IV. The ammonia criteria are dependent on ambient pH and temperature. The 95th percentile of the data collected upstream of the facility between January 1969 and August 1977 was used to determine the appropriate criteria. During the spring, the 95th percentile of temperature and pH is 16° C and 8.1 standard units respectively; during the irrigation season, the 95% percentile of temperature and pH is 20° C and 8.0 standard units respectively. During the winter, the 95th percentile of temperature and pH is 8° C and 8.1 standard units respectively.

2. pH values must be within the range of 6.5 - 9.5.

3. The total concentration of dissolved gas not exceeding 110% of saturation at atmospheric pressure at the point of sample collection.

4. Dissolved Oxyen Concentrations must exceed 6 mg/L at all times.

5. Water temperature must be 22°C or less with a maximum daily average of no greater than 19 °C .

6. Turbidity, below any applicable mixing zone set by the Department, shall not exceed background turbidity by more than 50 NTU instantaneously or more than 25 NTU for more than 10 consecutive days.

7. Surface waters shall be free from floating, suspended or submerged materials.

8. Surface waters shall be free from toxic substances in concentration that impair designated beneficial

9. Surface waters of the state shall be free from excess nutrients that can cause visible slime growths or other nuisance aquatic growths iimpairing designated beneficial uses.

Criteria for the protection of primary contact recreation:

1.

Parameter	Human Health Criteria
Arsenic (µg/L)	50
Nickel (µg/L)	4600

2. Fecal coliform bacteria are not to exceed:

   a. 500/100 ml at any time; or

   b. 200/100 ml in more than 10 percent (10%) of the total samples taken over a thirty (30) day period; or

   c. a geometric mean of 50/100 ml based on a minimum of five (5) samples taken over a thirty (30) day period.

Criteria for the protection of secondary contact recreation:

1.

Parameter	Human Health Criteria
Arsenic (µg/L)	50
Nickel (µg/L)	4600

2. Fecal coliform bacteria are not to exceed:

   a. 800 colonies/100ml at any time; or
   b. 400 colonies/100 ml in more than 10% of the samples taken over 30 days; or
   c. a geometric mean of 200 colonies/100 ml based on a minimum of 5 samples taken over a thirty day period.

3. Surface waters shall be free from floating, suspended or submerged materials.

4. Surface waters shall be free from toxic substances in concentration that impair designated beneficial uses.

<u>Criteria for the protection of agricultural use:</u>

Parameter	Livestock Criteria	Irrigation Criteria
Arsenic (µg/L)	200	100
Cadmium (µg/L)	50	10
Chromium (µg/L)	1000	100
Copper (µg/L)	500	200
Lead (µg/L)	50	5000
Nickel (µg/L)	NA	200
Zinc (µg/L)	25000	2000
Nitrates & Nitrites (mg/L)	100	NA
Nitrites (mg/L)	10	NA
NOTE: NA = not applicable		

2. Surface waters shall be free from floating, suspended or submerged materials.

3. Surface waters shall be free from toxic substances in concentration that impair designated beneficial uses.

APPENDIX B
Reasonable Potential Determination

To determine if a water quality based effluent limitation is required, the receiving water concentration of pollutants is determined downstream of where the effluent enters the receiving water. If the projected receiving water concentration is greater than the applicable numeric criterion for a specific pollutant, there is reasonable potential that the discharge may cause or contribute to an excursion above the applicable water quality standard and an effluent limit must be incorporated into the NPDES permit.

The receiving water concentration is determined using the following mass balance equation.

$$C_d \times Q_d = (C_e \times Q_e) + (C_u \times Q_u)$$

$$C_d = \frac{(C_e \times Q_e) + (C_u \times Q_u)}{Q_d}$$

where,
C_d = receiving water concentration downstream of the effluent discharge
Q_d = receiving water flow downstream of the effluent discharge
C_e = maximum projected effluent concentration
Q_e = maximum effluent flow
C_u = upstream concentration of pollutant
Q_u = upstream flow

Mixing Zone/Flow Conditions

The USGS gage nearest Caldwell is located approximately 10 miles upstream at Middleton. To estimate flows at Caldwell, contributions from the major tributaries and drains between Middleton and Caldwell were added to the USGS flows recorded at Middleton. Similarly, the major diversions were subtracted from the Middleton gage data.

The Idaho water quality standards at IDAPA 16.01.02060 allow twenty-five percent (25%) of the receiving water to be used for dilution for aquatic life criteria. One hundred percent (100%) of the receiving water can be used for dilution for human health criteria. The flows used to evaluate compliance with the criteria are:

- The 1 day, 10 year low flow (1Q10) is used for the protection of aquatic life from acute effects. It represents the lowest daily flow that is expected to occur once in 10 years. The 1Q10 for the Boise River at Caldwell is:

High	76 cfs
Irrigation	126 cfs

Low	115 cfs

- The 7 day, 10 year low flow (7Q10) is used for the protection of aquatic life from chronic effects. It is the lowest 7 day average flow expected to occur once in 10 years. The 7Q10 for the Boise River at Caldwell is:

High	303 cfs
Irrigation	325 cfs
Low	124 cfs

- The 30 day, 5 year low flow (30Q5) is used for the protection of human health from non-carcinogens. It represents the 30 day average flow expected to occur once in 5 years. When there are not sufficient data to determine the 30Q5, EPA's *Technical Support Document for Water Quality-Based Toxics Control* (TSD), page 89 recommends using 1.1 X 7Q10. Using this method, the estimated 30Q5 for the Boise River at Caldwell is:

High	333 cfs
Irrigation	357 cfs
Low	136 cfs

- The harmonic mean flow is used for the protection of human health from carcinogens. It is the number of daily flow measurements divided by the sum of the reciprocals of the flows. When there are not sufficient data to determine the harmonic mean, the TSD (pg. 88) recommends using 3 X 7Q10. Using this method, the estimated harmonic mean flow for the Boise River at Caldwell is:

High	909 cfs
Irrigation	975 cfs
Low	372 cfs

In accordance with state water quality standards, only the Division of Environmental Quality may authorize mixing zones. The reasonable potential calculations are based on a mixing zone of 25% for aquatic life and 100% for human health and agriculture. If the State does not authorize a mixing zone in its 401 certification, the permit limits will be re-calculated to ensure compliance with the standards at the point of discharge.

If a mixing zone (%MZ) is allowed, the mass balance equation becomes

$$C_d = \frac{(C_e \times Q_e) + (C_u \times (Q_u \times \%MZ))}{Q_e + (Q_u \times \%MZ)}$$

NOTE: $Q_d = Q_e + (Q_u \times \%MZ)$

Maximum Projected Effluent Concentration

When determining the projected receiving water concentration, EPA's *Technical Support Document for Water Quality-based Toxics Controls (1991)* recommends using the maximum projected effluent concentration. To determine the maximum projected effluent concentration (C_e) EPA has developed a statistical approach to better characterize the effects of effluent variability. The approach combines knowledge of effluent variability as estimated by a coefficient of variation (CV) with the uncertainty due to a limited number of data to project an estimated maximum concentration for the effluent. Once the CV for each parameter has been calculated, the reasonable potential multiplier used to derive the maximum projected effluent concentration (C_e) can be found in Table 3-1 of the TSD.

The maximum projected concentration (C_e) for the effluent is equal to the 95th percentile observed concentration value (or the highest observed value if the 95th percentile cannot be calculated) of the data set multiplied by the reasonable potential multiplier.

The following table summarizes the CV's, reasonable potential multipliers, 95th percentile effluent concentration and maximum projected concentration (C_e) for each parameter.

TABLE 1 - HIGH

Parameter	Coefficient of Variation[1] (CV)	Reasonable Potential Multiplier	95th Percentile effluent concentration, µg/L	Maximum Projected Effluent Concentration (C_e), µg/L
Arsenic	0.6	5.6	9.0	50.4
Cadmium	NA[2]	1.0	0.40	0.40
Chromium	0.6	5.6	25.7	143.92
Copper	NA[2]	1.0	9.58	9.58
Lead	NA[2]	1.0	0.54	0.54
Nickel	NA[2]	1.0	3.2	3.2
Zinc	0.6	5.6	33.40	187.04
Silver	NA[2]	1.0	0.08	0.08
Mercury	.6	5.6	0.054	0.3024
Chlorine	0.5	2.0	1000	2000
Ammonia[3]	0.6	---	---	6.1 mg/L

1. The CV for chlorine was calculated using effluent data collected from January 1989 through November 1997. Effluent data for metals are collected twice yearly since 1994 using current sensitive collection and analytical methods. The default CV of 0.6 was used for ammonia due to the limited number of samples (8 total over a 10-year period).
2. Data were either at the method detection limit or below it, therefore, a CV could not be calculated.
3. The 99th percentile effluent sample value is 6.1 mg/L.

TABLE 1 - IRRIGATION

Parameter	Coefficient of Variation[1] (CV)	Reasonable Potential Multiplier	95th Percentile effluent concentration, µg/L	Maximum Projected Effluent Concentration (C_e), µg/L
Arsenic	0.4	2.0	15	30
Cadmium	0.8	3.7	0.5	1.85
Chromium	0.9	4.2	5.22	21.924
Copper	0.5	2.4	20	48
Lead	0.8	3.7	6.89	25.493
Nickel	0.5	2.4	6.9	16.56
Zinc	0.5	2.4	73.7	176.88
Silver	0.4	2.0	2.0	4.0
Mercury	0.6	3.2	0.3	0.96
Chlorine	0.5	2.0	1000	2000
Ammonia[2]	0.6	---	---	6.1 mg/L

1. The CV for chlorine was calculated using effluent data collected from January 1989 through November 1997. Effluent data for metals are collected twice yearly since 1994 using current sensitive collection and analytical methods. The default CV of 0.6 was used for ammonia due to the limited number of samples (8 total over a 10-year period).
2. The 99th percentile effluent sample value is 6.1 mg/L.

TABLE 1 - LOW

Parameter	Coefficient of Variation[1] (CV)	Reasonable Potential Multiplier	95th Percentile effluent concentration, µg/L	Maximum Projected Effluent Concentration (C_e), µg/L
Arsenic	0.6	3.2	11.2	35.84
Cadmium	0.6	3.2	2.56	8.19
Chromium	0.6	3.2	10.9	34.88
Copper	0.6	3.2	46.7	149.44
Lead	0.6	3.2	18.0	57.6
Nickel	0.6	3.2	7.73	24.74
Zinc	0.6	3.2	126	403.2
Silver	0.6	3.2	4.68	14.98
Mercury	0.6	3.2	0.2	0.64
Chlorine	0.5	2.0	1000	2000
Ammonia[2]	0.6	---	---	6.1 mg/L

1. The CV for chlorine was calculated using effluent data collected from January 1989 through November 1997. Effluent data for metals are collected twice yearly since 1994 using current sensitive collection and analytical methods. The default CV of 0.6 was used for ammonia due to the limited number of samples (8 total over a 10-year period).
2. The 99th percentile effluent sample value is 6.1 mg/L.

Dissolved vs Total Metals

When determining the reasonable potential of these parameters to violate water quality standards the projected receiving water concentration is compared to the criteria. The aquatic life criteria for arsenic, cadmium, chromium, copper, lead, nickel and zinc are expressed as dissolved. The maximum projected receiving water concentration is expressed as total.

The dissolved metal is the concentration of an analyte that will pass through a 0.45 micron membrane filter assembly. The total metal is the concentration of analyte in an unfiltered sample. Comparing the projected receiving water concentration, which is expressed as total, to a dissolved aquatic life criterion is a conservative evaluation.

Reasonable Potential Calculations

With the exception of chlorine and ammonia, all projected receiving water concentrations were below the water quality criteria for each season. Therefore, the only water quality-based limits required are for chlorine and ammonia. Reasonable potential calculations for each of the seasons in the river are presented below:

1. Chlorine - High

(a) Determine if there is reasonable potential for the acute aquatic life criterion to be violated. The upstream flow used to make the determination is the 1Q10 (76 cfs). Assume the State will allow a 25% mixing zone. There are no data available to determine the upstream concentration of chlorine.

$$C_d = \frac{(C_e \text{ X } Q_e) + (C_u \text{ X } (Q_u \text{ X } \%MZ))}{Q_e + (Q_u \text{ X } \%MZ)}$$

$$= \frac{(2000 \text{ X } 13) + (0 \text{ X } (76 \text{ X } .25)}{13 + (76 \text{ X } .25)} = 64.269\ \mu g/L$$

Since 64.269 µg/L is greater than the acute aquatic life criterion (19 µg/L), there is a reasonable potential for the effluent to cause an exceedance to the water quality standard. Therefore, a water quality-based effluent limit is required.

(b) Determine if there is reasonable potential for the chronic aquatic life criterion to be violated. The upstream flow used to make the determination is the 7Q10 (303 cfs). Assume the State will allow a 25% mixing zone. There are no data available to determine the upstream concentration of chlorine.

$$C_d = \frac{(C_e \text{ X } Q_e) + (C_u \text{ X } (Q_u \text{ X } \%MZ))}{Q_e + (Q_u \text{ X } \%MZ)}$$

$$= \frac{(2000 \text{ X } 13) + (0 \text{ X } (303 \text{ X } .25)}{13 + (303 \text{ X } .25)} = 29.462\ \mu g/L$$

Since 29.462 µg/L is greater than the chronic aquatic life criterion (11 µg/L), there is a reasonable potential for the effluent to cause an exceedance to the water quality standard. Therefore, a water quality based effluent limit is required.

2. Chlorine - Irrigation

(a) Determine if there is reasonable potential for the acute aquatic life criterion to be violated. The upstream flow used to make the determination is the 1Q10 (126 cfs). Assume the State will allow a 25% mixing zone. There are no data available to determine the upstream concentration of chlorine.

$$C_d = \frac{(2000 \text{ X } 13) + (0 \text{ X } (126 \text{ X } .25)}{13 + (126 \text{ X } .25)} = 584.270 \text{ µg/L}$$

Since 584.270 µg/L is greater than the acute aquatic life criterion (19 µg/L), there is a reasonable potential for the effluent to cause an exceedance to the water quality standard. Therefore, a water quality based effluent limit is required.

(b) Determine if there is reasonable potential for the chronic aquatic life criterion to be violated. The upstream flow used to make the determination is the 7Q10 (325 cfs). Assume the State will allow a 25% mixing zone.

$$C_d = \frac{(2000 \text{ X } 13) + (0 \text{ X } (325 \text{ X } .25)}{13 + (325 \text{ X } .25)} = 275.86 \text{ µg/L}$$

Since 275.86 is greater than the chronic aquatic life criterion (11 µg/L) , there is a reasonable potential for the effluent to cause an exceedance to the water quality standard. Therefore, a water quality based effluent limit is required.

3. Chlorine - Low

(a) Determine if there is reasonable potential for the acute aquatic life criterion to be violated. The upstream flow used to make the determination is the 1Q10 (115 cfs). Assume the State will allow a 25% mixing zone. There are no data available to determine the upstream concentration of chlorine.

$$C_d = \frac{(2000 \text{ X } 13) + (0 \text{ X } (115 \text{ X } .25)}{13 + (115 \text{ X } .25)} = 622.75 \text{ µg/L}$$

Since 622.75 µg/L is greater than the acute aquatic life criterion (19 µg/L), there is a reasonable potential for the effluent to cause an exceedance to the water quality standard. Therefore, a water quality based effluent limit is required.

(b) Determine if there is reasonable potential for the chronic aquatic life criterion to be violated. The upstream flow used to make the determination is the 7Q10 (124 cfs). Assume the State will allow a 25% mixing zone.

$$C_d = \frac{(2000 \times 13) + (0 \times (124 \times .25)}{13 + (124 \times .25)} = 590.909\ \mu g/L$$

Since 590.909 is greater than the chronic aquatic life criterion (11 µg/L) , there is a reasonable potential for the effluent to cause an exceedance to the water quality standard. Therefore, a water quality based effluent limit is required.

4. <u>Ammonia - High</u>

(a) Determine if there is reasonable potential for the acute aquatic life criterion to be violated. The upstream flow used to make the determination is the 1Q10 (76 cfs). Assume the State will allow a 25% mixing zone. The upstream concentration of ammonia in the Boise River is 0.11 mg/L for this time period.

$$C_d = \frac{(C_e \times Q_e) + (C_u \times (Q_u \times \%MZ))}{Q_e + (Q_u \times \%MZ)}$$

$$= \frac{(6.1 \times 13) + (.11 \times (76 \times .25)}{13 + (76 \times .25)} = 2.5\ mg/L$$

Since 2.5 mg/L is greater than the acute aquatic life criterion (1.3 mg/L), there is a reasonable potential for the effluent to cause an exceedance to the water quality standard. Therefore, a water quality-based effluent limit is required.

(b) Determine if there is reasonable potential for the chronic aquatic life criterion to be violated. The upstream flow used to make the determination is the 7Q10 (303 cfs). Assume the State will allow a 25% mixing zone. There are no data available to determine the upstream concentration of chlorine.

$$C_d = \frac{(C_e \times Q_e) + (C_u \times (Q_u \times \%MZ))}{Q_e + (Q_u \times \%MZ)}$$

$$= \frac{(6.1 \times 13) + (.11 \times (303 \times .25)}{13 + (303 \times .25)} = 0.99\ mg/L$$

Since 0.99 µg/L is greater than the chronic aquatic life criterion (0.29 mg/L), there is a reasonable potential for the effluent to cause an exceedance to the water quality standard. Therefore, a water quality based effluent limit is required.

5. Ammonia - Irrigation

(a) Determine if there is reasonable potential for the acute aquatic life criterion to be violated. The upstream flow used to make the determination is the 1Q10 (126 cfs). Assume the State will allow a 25% mixing zone. The upstream concentration of ammonia in the Boise River is 0.11 mg/L for this time period.

$$C_d = \frac{(6.1 \text{ X } 13) + (.11 \text{ X } (126 \text{ X } .25)}{13 + (126 \text{ X } .25)} = 1.86 \text{ mg/L}$$

Since 1.86 mg/L is less than the acute aquatic life criterion (5.63 mg/L), there is not a reasonable potential for the effluent to cause an exceedance to the water quality standard. Therefore, a water quality based effluent limit is not required.

(b) Determine if there is reasonable potential for the chronic aquatic life criterion to be violated. The upstream flow used to make the determination is the 7Q10 (325 cfs). Assume the State will allow a 25% mixing zone.

$$C_d = \frac{(6.1 \text{ X } 13) + (.11 \text{ X } (325 \text{ X } .25)}{13 + (325 \text{ X } .25)} = 0.94 \text{ mg/L}$$

Since 0.94 mg/L is greater than the chronic aquatic life criterion (0.93 mg/L) , there is a reasonable potential for the effluent to cause an exceedance to the water quality standard. Therefore, a water quality based effluent limit is required.

6. Ammonia - Low

(a) Determine if there is reasonable potential for the acute aquatic life criterion to be violated. The upstream flow used to make the determination is the 1Q10 (115 cfs). Assume the State will allow a 25% mixing zone. The upstream concentration of ammonia in the Boise river is 0.3 mg/L for this time period.

$$C_d = \frac{(6.1 \text{ X } 13) + (.3 \text{ X } (115 \text{ X } .25)}{13 + (115 \text{ X } .25)} = 2.11 \text{ mg/L}$$

Since 2.11 mg/L is less than the acute aquatic life criterion (4.9 mg/L), there is not a reasonable potential for the effluent to cause an exceedance to the water quality standard. Therefore, a water quality based effluent limit is not required.

(b) Determine if there is reasonable potential for the chronic aquatic life criterion to be violated. The upstream flow used to make the determination is the 7Q10 (124 cfs). Assume the State will allow a 25% mixing zone.

$$C_d = \frac{(6.1 \text{ X } 13) + (.3 \text{ X } (124 \text{ X } .25)}{13 + (124 \text{ X } .25)} = 2.01 \text{ mg/L}$$

Since 2.01 mg/L is greater than the chronic aquatic life criterion (1.13 mg/L) , there is a reasonable potential for the effluent to cause an exceedance to the water quality standard. Therefore, a water quality based effluent limit is required.

APPENDIX C
Derivation of Water Quality Based Effluent Limitations

The purpose of a permit limit is to specify an upper bound of acceptable effluent quality. For water quality based requirements, the permit limits are based on maintaining the effluent quality at a level that will comply with the water quality standards, even during critical conditions in the receiving water (i.e., low flows). These requirements are determined by the wasteload allocation (WLA). The WLA dictates the required effluent quality which, in turn, defines the desired level of treatment plant performance or target Long-term average (LTA).

To support the implementation of EPA's national policy for controlling the discharge of toxicants, EPA developed the "Technical Support Document for Water Quality-Based Toxics Control" (EPA/505/2-90-001, March 1991). The following is a summary of the procedures recommended in the TSD in deriving water quality-based effluent limitations for toxicants. This procedure translates water quality criteria for chlorine and ammonia to "end of the pipe" effluent limits.

Step 1

The acute and chronic aquatic life criteria are converted to acute and chronic waste load allocations (WLA_{acute} or $WLA_{chronic}$) for the receiving waters based on the following mass balance equation:

$$Q_dC_d = Q_eC_e + Q_uC_u$$

where,	Q_d =	downstream flow = $Q_u + Q_e$
	C_d =	aquatic life criteria that cannot be exceeded downstream
	Q_e =	effluent flow
	C_e =	concentration of pollutant in effluent = WLA_{acute} or $WLA_{chronic}$
	Q_u =	upstream flow
	C_u =	upstream background concentration of pollutant

Rearranging the above equation to determine the effluent concentration (C_e) or the wasteload allocation (WLA) results in the following:

$$C_e = WLA = \frac{Q_dC_d - Q_uC_u}{Q_e}$$

when a mixing zone is allowed, this equation becomes:

$$C_e = WLA= \underline{C_d(Q_u \text{ X } \%MZ) + C_dQ_e - Q_uC_u(\%MZ)}$$

Q_e Q_e

where, %MZ is the mixing zone[1] allowable by the state standards. The Idaho water quality standards at IDAPA 16.01.02060 allow twenty-five percent (25%) of the receiving water to be used for dilution for aquatic life criteria. The effluent limits have been derived using Idaho's guidelines for mixing zone. However, establishing a mixing zone is a State discretionary function; if the State does not certify a mixing zone in the 401 certification process, the effluent limits will be recalculated without a mixing zone.

High

$$\text{Chlorine } WLA_{acute} = \frac{C_d(Q_u \times \%MZ) + C_d Q_e}{Q_e} - \frac{Q_u C_u(\%MZ)}{Q_e}$$

$$= \frac{19(76 \times .25) + (19 \times 13)}{13} - \frac{76 \times 0\ (.25)}{13} = 40.92\ \mu g/L$$

$$\text{Chlorine } WLA_{chronic} = \frac{11(303 \times .25) + (11 \times 13)}{13} - \frac{303 \times 0\ (.25)}{13} = 51.788\ \mu g/L$$

Step 2

The acute and chronic WLAs are then converted to Long Term Average concentrations (LTA_a and LTA_c) using the following equations:

$LTA_{acute} = WLA_{acute} \times e^{[0.5\sigma^2 - z\sigma]}$

where,

σ^2 = $\ln(CV^2 + 1)$

z = 2.326 for 99th percentile probability basis

CV = coefficient of variation = standard deviation/mean; $Cv_{chlorine}$ = .5

$LTA_{chronic} = WLA_{chronic} \times e^{[0.5\sigma^2 - z\sigma]}$

where,

σ^2 = $\ln(CV^2/4 + 1)$

z = 2.326 for 99th percentile probability basis

CV = coefficient of variation = standard deviation/mean

Calculate the LTA_{acute} and the $LTA_{chronic}$:

[1] Mixing zone - is an allocated impact zone where water quality criteria can be exceeded as long as acutely toxic conditions are prevented. Only the State of Idaho has the regulatory authority to grant a mixing zone.

Chlorine LTA_{acute} = 15 µg/L
Chlorine $LTA_{chronic}$ = 30 µg/L

Step 3

To protect a waterbody from both acute and chronic effects, the more limiting of the calculated LTA_{acute} and $LTA_{chronic}$ is used to derive the effluent limitations. The TSD recommends using the 95th percentile for the Average Monthly Limit (AML) and the 99th percentile for the Maximum Daily Limit (MDL).

Step 4

1. The MDL and the AML would be calculated as follows:

$MDL = LTA_{acute} \times e^{[z\sigma-0.5\sigma^2]}$
where,
σ^2 = $\ln(CV^2 + 1)$
z = 2.326 for 99th percentile probability basis
CV = coefficient of variation
LTA_{acute} = 15 µg/L
$e^{[z\sigma-0.5\sigma^2]}$ = 2.68
MDL = 40.2 µg/L

$AML = LTA_{acute} \times e^{[z\sigma- 0.5\sigma^2]}$
where,
σ^2 = $\ln(CV^2/n + 1)$
z = 1.645 for 95th percentile probability basis
CV = coefficient of variation = standard deviation/mean
n = number of sampling events required per month for chlorine = 20
LTA_{acute} = 15 µg/L
$e^{[z\sigma-0.5\sigma^2]}$ = 1.19
AML = 17.9

Irrigation

Chlorine WLA_{acute} $= \dfrac{C_d(Q_u \times \%MZ) + C_dQ_e}{Q_e} - \dfrac{Q_uC_u(\%MZ)}{Q_e}$

$= \dfrac{19(126 \times .25) + (19 \times 13)}{13} - \dfrac{126 \times 0\ (.25)}{13} = 55.3$ µg/L

Chlorine $WLA_{chronic}$ $= \dfrac{11(325 \times .25) + (11 \times 13)}{}$

$$\frac{325 \text{ X } 0\ (.25)}{13} = 54.8\ \mu g/L$$

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Step 2

The acute and chronic WLAs are then converted to Long Term Average concentrations (LTA_a and LTA_c) using the following equations:

$LTA_{acute} = WLA_{acute} \text{ X } e^{[0.5\sigma^2 - z\sigma]}$
where,
σ^2 = $\ln(CV^2 + 1)$
z = 2.326 for 99^{th} percentile probability basis
CV = coefficient of variation = standard deviation/mean; $Cv_{chlorine}$ = .5

$LTA_{chronic} = WLA_{chronic} \text{ X } e^{[0.5\sigma^2 - z\sigma]}$

where,
σ^2 = $\ln(CV^2/n + 1)$
z = 2.326 for 99^{th} percentile probability basis
CV = coefficient of variation = standard deviation/mean
n = number of sampling events required per month for chlorine = 20
Calculate the LTA_{acute} and the $LTA_{chronic}$:

Chlorine LTA_{acute}	= 21 µg/L
Chlorine $LTA_{chronic}$	= 31 µg/L

Step 3

To protect a waterbody from both acute and chronic effects, the more limiting of the calculated LTA_{acute} and $LTA_{chronic}$ is used to derive the effluent limitations. The TSD recommends using the 95^{th} percentile for the Average Monthly Limit (AML) and the 99^{th} percentile for the Maximum Daily Limit (MDL).

Step 4

1. The MDL and the AML would be calculated as follows:

$MDL = LTA_{acute} \text{ X } e^{[z\sigma - 0.5\sigma^2]}$

where,
σ^2 = $\ln(CV^2 + 1)$
z = 2.326 for 99^{th} percentile probability basis
CV = coefficient of variation
LTA_{acute} = 21 µg/L
$e^{[z\sigma - 0.5\sigma^2]}$ = 2.68
MDL = 56.3 µg/L

$AML = LTA_{acute} \times e^{[z\sigma - 0.5\sigma^2]}$

where,

σ^2	$= \ln(CV^2/n + 1)$
z	= 1.645 for 95th percentile probability basis
CV	= coefficient of variation = standard deviation/mean
n	= number of sampling events required per month for chlorine = 20
LTA_{acute}	= 21 µg/L
$e^{[z\sigma - 0.5\sigma^2]}$	= 1.19
AML	= 25 µg/L

Low

Chlorine WLA_{acute} $= \dfrac{C_d(Q_u \times \%MZ) + C_dQ_e - Q_uC_u(\%MZ)}{Q_e}$

$= \dfrac{19(115 \times .25) + (19 \times 13) - 115 \times 0\ (.25)}{13} = 58.807$ µg/L

Chlorine $WLA_{chronic}$ $= \dfrac{11(124 \times .25) + (11 \times 13) - 124 \times 0\ (.25)}{13} = 27.693$ µg/L

Step 2

The acute and chronic WLAs are then converted to Long Term Average concentrations (LTA_a and LTA_c) using the following equations:

$LTA_{acute} = WLA_{acute} \times e^{[0.5\sigma^2 - z\sigma]}$

where,

σ^2	$= \ln(CV^2 + 1)$
z	= 2.326 for 99th percentile probability basis
CV	= coefficient of variation = standard deviation/mean; $Cv_{chlorine}$ = .5

$LTA_{chronic} = WLA_{chronic} \times e^{[0.5\sigma^2 - z\sigma]}$

where,

σ^2	$= \ln(CV^2/4 + 1)$
z	= 2.326 for 99th percentile probability basis
CV	= coefficient of variation = standard deviation/mean

Calculate the LTA_{acute} and the $LTA_{chronic}$:

Chlorine LTA_{acute} = 22 µg/L

Chlorine $LTA_{chronic}$ = 16 µg/L

Step 3

To protect a waterbody from both acute and chronic effects, the more limiting of the calculated LTA_{acute} and $LTA_{chronic}$ is used to derive the effluent limitations. The TSD recommends using the 95th percentile for the Average Monthly Limit (AML) and the 99th percentile for the Maximum Daily Limit (MDL).

Step 4

1. The MDL and the AML would be calculated as follows:

$MDL = LTA_{chronic} \times e^{[z\sigma - 0.5\sigma^2]}$

where,

σ^2 = $\ln(CV^2 + 1)$

z = 2.326 for 99th percentile probability basis

CV = coefficient of variation

$LTA_{chronic}$ = 16

$e^{[z\sigma - 0.5\sigma^2]}$ = 2.38

MDL = 43.0 µg/L

$AML = LTA_{chronic} \times e^{[z\sigma - 0.5\sigma^2]}$

where,

σ^2 = $\ln(CV^2/n + 1)$

z = 1.645 for 95th percentile probability basis

CV = coefficient of variation = standard deviation/mean

n = number of sampling events required per month for chlorine = 20

$LTA_{chronic}$ = 16

$e^{[z\sigma - 0.5\sigma^2]}$ = 1.19

AML =19.0 µg/L

Ammonia - High

$$\text{Ammonia } WLA_{acute} = \frac{C_d(Q_u \times \%MZ) + C_dQ_e - Q_uC_u(\%MZ)}{Q_e}$$

$$= \frac{1.3(76 \times .25) + (1.3 \times 13)}{13} - \frac{76 \times .11\ (.25)}{13} = 3.04 \text{ mg/L}$$

$$\text{Ammonia } WLA_{chronic} = \frac{.29(303 \times .25) + (.29 \times 13)}{13} - \frac{303 \times .11\ (.25)}{13} = 1.34 \text{ mg/L}$$

Step 2

The acute and chronic WLAs are then converted to Long Term Average concentrations (LTA_a and LTA_c) using the following equations:

$LTA_{acute} = WLA_{acute} \times e^{[0.5\sigma^2 - z\sigma]}$
where,
σ^2 = $\ln(CV^2 + 1)$
z = 2.326 for 99th percentile probability basis
CV = coefficient of variation = default value of .6 was used for ammonia due to limited number of samples.

$LTA_{chronic} = WLA_{chronic} \times e^{[0.5\sigma^2 - z\sigma]}$

where,
σ^2 = $\ln(CV^2/4 + 1)$
z = 2.326 for 99th percentile probability basis
CV = coefficient of variation = default value of .6

Calculate the LTA_{acute} and the $LTA_{chronic}$:

Ammonia LTA_{acute} = 0.976 mg/L
Ammonia $LTA_{chronic}$ = 0.706 mg/L

Step 3

To protect a waterbody from both acute and chronic effects, the more limiting of the calculated LTA_{acute} and $LTA_{chronic}$ is used to derive the effluent limitations. The TSD recommends using the 95th percentile for the Average Monthly Limit (AML) and the 99th percentile for the Maximum Daily Limit (MDL).

Step 4

1. The MDL and the AML would be calculated as follows:

$MDL = LTA_{chronic} \times e^{[z\sigma - 0.5\sigma^2]}$
where,

σ^2 = $\ln(CV^2 + 1)$
z = 2.326 for 99th percentile probability basis
CV = coefficient of variation
$LTA_{chronic}$ = 0.706 mg/L
$e^{[z\sigma - 0.5\sigma^2]}$ = 3.11
MDL = 2.20 mg/L

$AML = LTA_{chronic} \times e^{[z\sigma - 0.5\sigma^2]}$
where,

σ^2 = $\ln(CV^2/n + 1)$
z = 1.645 for 95th percentile probability basis
CV = coefficient of variation = default value of .6
n = number of sampling events required per month for ammonia = 4
$LTA_{chronic}$ = 0.706 mg/L
$e^{[z\sigma - 0.5\sigma^2]}$ = 1.55
AML = 1.09 mg/L

Ammonia - Irrigation

$$\text{Ammonia } WLA_{acute} = \frac{C_d(Q_u \times \%MZ) + C_dQ_e}{Q_e} - \frac{Q_uC_u(\%MZ)}{Q_e}$$

$$= \frac{5.63(126 \times .25) + (5.63 \times 13)}{13} - \frac{126 \times .11\ (.25)}{13} = 19 \text{ mg/L}$$

$$\text{Ammonia } WLA_{chronic} = \frac{.93(325 \times .25) + (.93 \times 13)}{13} - \frac{325 \times .11\ (.25)}{13} = 6.05 \text{ mg/L}$$

Step 2

The acute and chronic WLAs are then converted to Long Term Average concentrations (LTA_a and LTA_c) using the following equations:

$LTA_{acute} = WLA_{acute} \times e^{[0.5\sigma^2 - z\sigma]}$
where,

σ^2 = $\ln(CV^2 + 1)$
z = 2.326 for 99th percentile probability basis

CV = coefficient of variation = default value of .6 for ammonia due to limited number of samples

$LTA_{chronic} = WLA_{chronic} \times e^{[0.5\sigma^2 - z\sigma]}$

where,
σ^2 = $\ln(CV^2/n + 1)$
z = 2.326 for 99th percentile probability basis
CV = coefficient of variation = default value of .6
n = number of sampling events required per month for ammonia = 4

Calculate the LTA_{acute} and the $LTA_{chronic}$:

Ammonia LTA_{acute} = 6.10 mg/L
Ammonia $LTA_{chronic}$ = 3.19 mg/L

Step 3

To protect a waterbody from both acute and chronic effects, the more limiting of the calculated LTA_{acute} and $LTA_{chronic}$ is used to derive the effluent limitations. The TSD recommends using the 95th percentile for the Average Monthly Limit (AML) and the 99th percentile for the Maximum Daily Limit (MDL).

Step 4

1. The MDL and the AML would be calculated as follows:

$MDL = LTA_{chronic} \times e^{[z\sigma - 0.5\sigma^2]}$
where,
σ^2 = $\ln(CV^2 + 1)$
z = 2.326 for 99th percentile probability basis
CV = coefficient of variation
$LTA_{chronic}$ = 3.19 µg/L
$e^{[z\sigma - 0.5\sigma^2]}$ = 3.11
MDL = 9.92 mg/L

$AML = LTA_{chronic} \times e^{[z\sigma - 0.5\sigma^2]}$
where,
σ^2 = $\ln(CV^2/n + 1)$
z = 1.645 for 95th percentile probability basis
CV = coefficient of variation = default value of .6
n = number of sampling events required per month for ammonia = 4
$LTA_{chronic}$ = 3.19 mg/L
$e^{[z\sigma - 0.5\sigma^2]}$ = 1.55
AML = 4.94 mg/L

Ammonia - Low

Ammonia WLA_{acute} = $\frac{C_d(Q_u \times \%MZ) + C_dQ_e - Q_uC_u(\%MZ)}{Q_e}$

$$= \frac{4.9(115 \times .25) + (4.9 \times 13) - 115 \times .3\ (.25)}{13} = 15.08 \text{ mg/L}$$

Ammonia $WLA_{chronic}$ = $\frac{1.13(124 \times .25) + (1.13 \times 13) - 124 \times .3\ (.25)}{13}$ = 3.1 mg/L

Step 2

The acute and chronic WLAs are then converted to Long Term Average concentrations (LTA_a and LTA_c) using the following equations:

$LTA_{acute} = WLA_{acute} \times e^{[0.5\sigma^2 - z\sigma]}$

where,

σ^2 = $\ln(CV^2 + 1)$

z = 2.326 for 99th percentile probability basis

CV = coefficient of variation = default value of .6 for ammonia due to limited number of samples

$LTA_{chronic} = WLA_{chronic} \times e^{[0.5\sigma^2 - z\sigma]}$

where,

σ^2 = $\ln(CV^2/4 + 1)$

z = 2.326 for 99th percentile probability basis

CV = coefficient of variation - default value of .6

Calculate the LTA_{acute} and the $LTA_{chronic}$:

Ammonia LTA_{acute} = 4.84 mg/L

Chlorine $LTA_{chronic}$ = 1.63 mg/L

Step 3

To protect a waterbody from both acute and chronic effects, the more limiting of the calculated LTA_{acute} and $LTA_{chronic}$ is used to derive the effluent limitations. The TSD recommends using the 95th percentile for the Average Monthly Limit (AML) and the 99th percentile for the Maximum Daily Limit (MDL).

Step 4

1. The MDL and the AML would be calculated as follows:

$MDL = LTA_{chronic} \times e^{[z\sigma - 0.5\sigma^2]}$
where,
σ^2 = $\ln(CV^2 + 1)$
z = 2.326 for 99th percentile probability basis
CV = coefficient of variation = default value of .6
$LTA_{chronic}$ = 1.63
$e^{[z\sigma - 0.5\sigma^2]}$ = 3.11
MDL = 5.07 mg/L

$AML = LTA_{chronic} \times e^{[z\sigma - 0.5\sigma^2]}$
where,
σ^2 = $\ln(CV^2/n + 1)$
z = 1.645 for 95th percentile probability basis
CV = coefficient of variation = default value of .6
n = number of sampling events required per month for ammonia = 4
$LTA_{chronic}$ = 1.63
$e^{[z\sigma - 0.5\sigma^2]}$ = 1.55
AML =2.53 mg/L

The following table lists the effluent limitations for Outfall 001 by season:

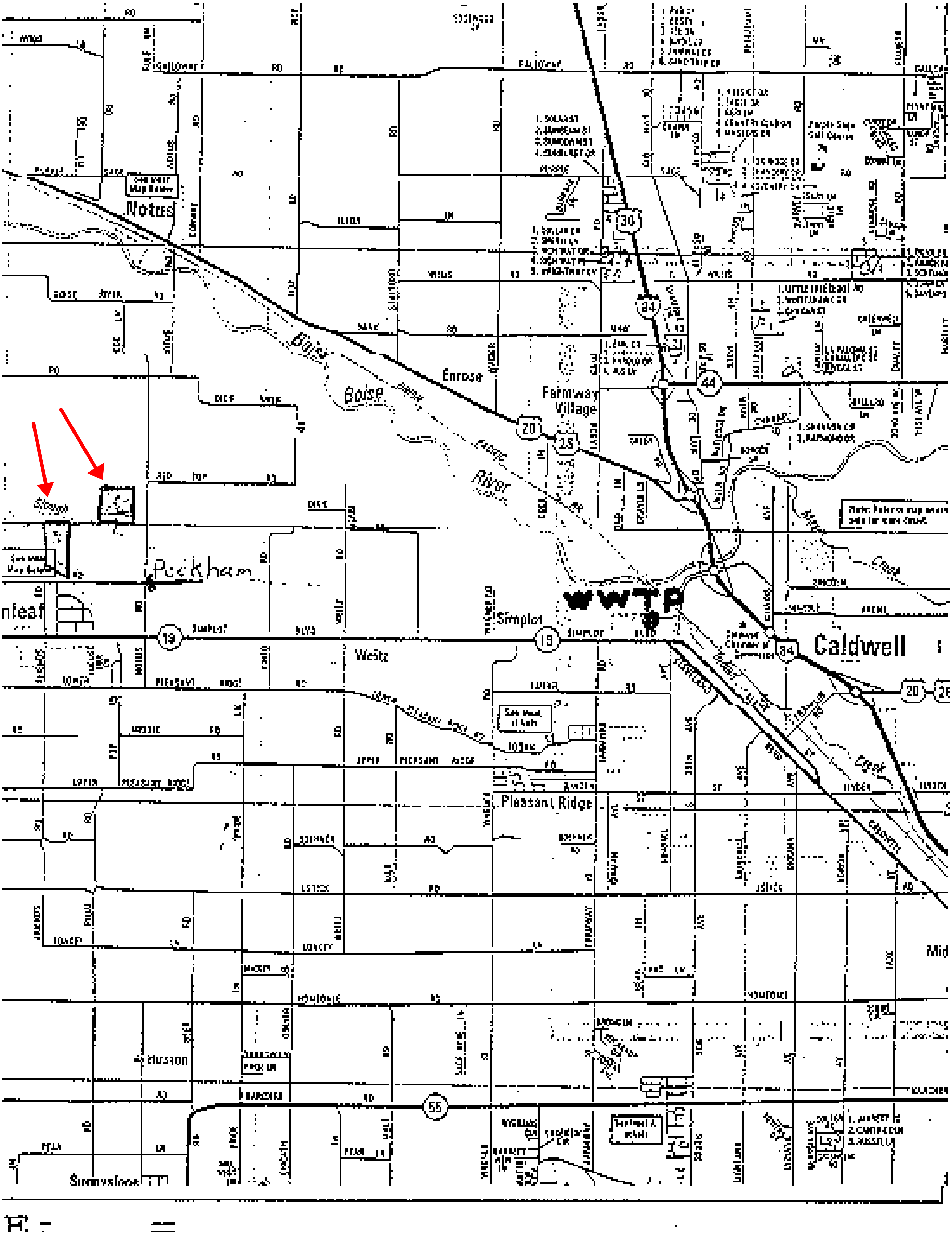
TABLE 2

Outfall 001	WATER QUALITY-BASED LIMITATIONS			
	CHLORINE		AMMONIA	
	MAX. DAILY	AVE. MONTHLY	MAX. DAILY	AVE. MONTHLY
High	40.2 μg/L	17.9μg/L	2.20 mg/L	1.09 mg/L
Irrigation	56.3 μg/L	25.0 μg/L	9.92 mg/L	4.94 mg/L
Low	43.0 μg/L	19.0 μg/L	5.07 mg/L	2.53 mg/L

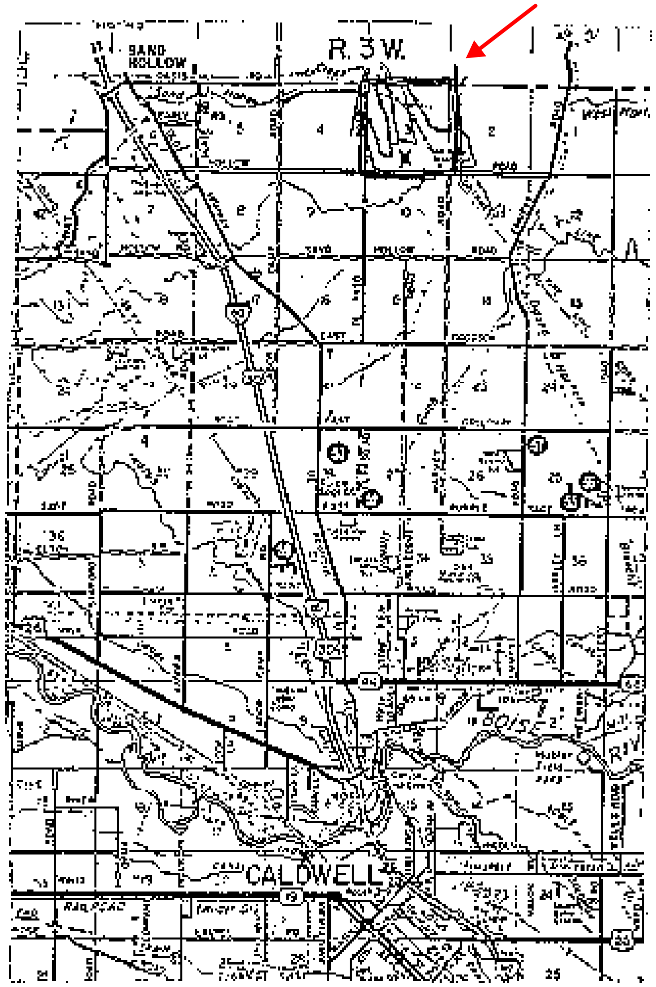
APPENDIX D
Outfall Location Map

APPENDIX E
Land Application Sites

Contact the Nickie Arnold <arnold.nickie@epamail.epa.gov>, Idaho Operations Office, 208-378-5757, or Jeanette Carriveau <carriveau.jeanette@epamail.epa.gov>. 206-553-1214 for copies of these maps.



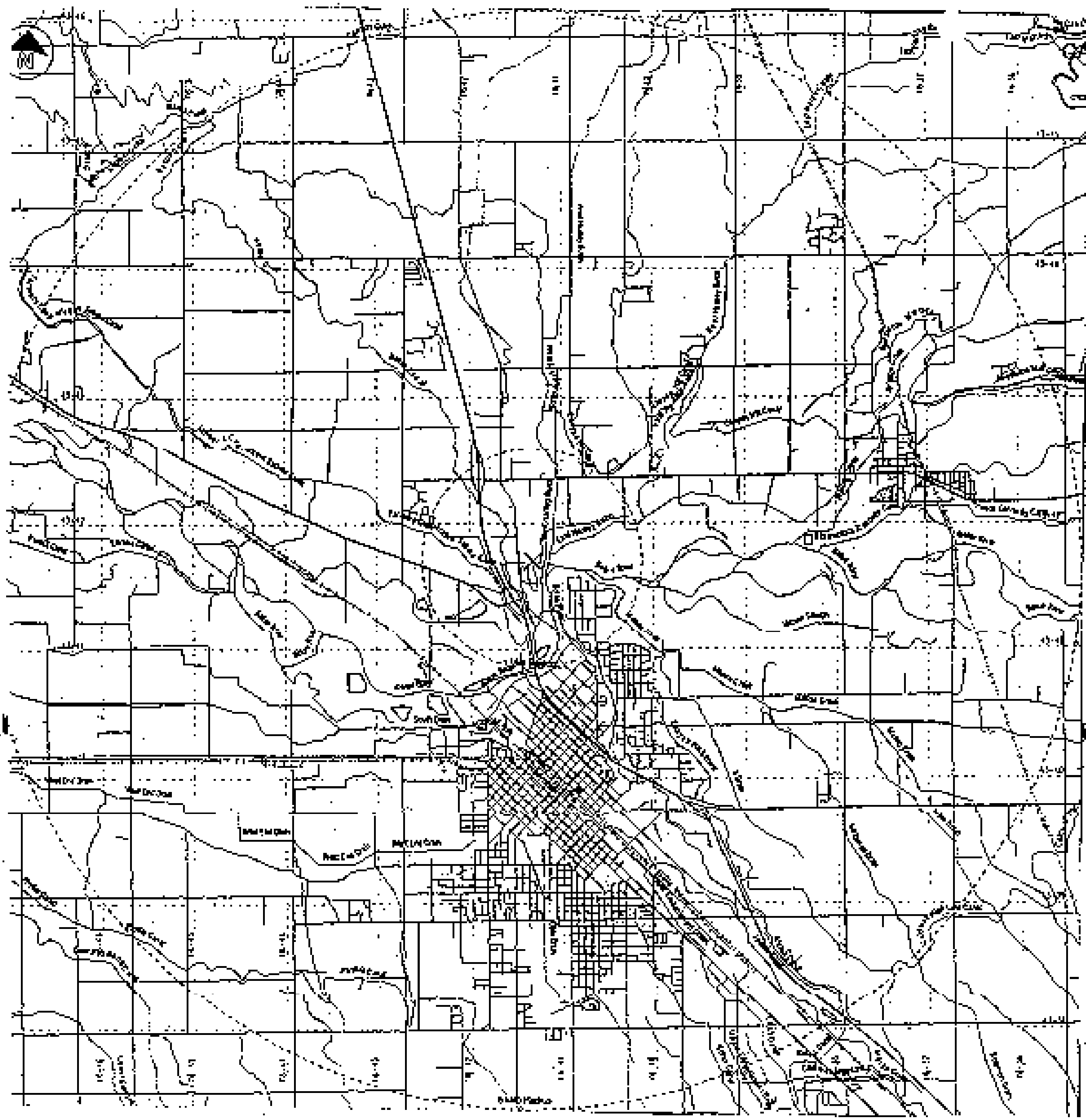
Appendix D-1: General Boundary of Land Application Sites



D-2: General Boundary of Land Application Site

APPENDIX E

Site Map



APPENDIX F
D.O. Sag Models

DO SAG MODEL

This model analyzes dissolved oxygen sag in a river, based on the Streeter-Phelps equation and Water Quality Assessment: A Screening Procedure for Toxic and Conventional Pollutants in Surface and Ground Water - Part I (Revised - 1985) [EPA/600/6-85/002a]

Nomenclature

Variable	Unit	Description
Cu	mg/L	Upstream DO
Cw	mg/L	Effluent DO
D		Dissolved oxygen deficit at point x
Dc	mg/L	Concentration at the sag point
Do	mg/L	Initial oxygen deficit at x=0
e		Natural logarithm, base e
H	ft	Stream depth
ka	L/day	Reaeration constant
kL	L/day	BOD decay coefficient
Lo	mg/L	Ultimate BOD at point x=0
Lu	mg/L	Upstream ultimate BOD
P		Reaeration due to photosynthesis
Qd	cfs	Downstream flow rate
Qu	cfs	Upstream flow rate
Qw	cfs	Effluent design flow rate
R		Oxygen demand due to algal respiration
S		Sediment oxygen demand
t	s	Time when the effluent reaches point x (x/U)
tc	days	Time to reach minimum DO
U	fps	Stream velocity
w	ft	Stream width
W	lbs/day	Effluent ultimate BOD = BOD5/0.68
xc	miles	Distance downstream to sag point

Assumptions

1. Constant cross-sectional area of receiving water
2. Do=1-2 mg/L due to lack of data
3. BOD/DO effects from S, R, and P are negligible

4. Use max. daily BOD5 effluent limit

5. 7Q10 receiving water flows used to determine stream velocity (U).

6. Convert Q in mgd to cfs by Q(cfs) = Q(mgd)*1.55

Insert the following information:

Facility Name:	Lower Boise
NPDES No:	ID-002150-4

Lu =	8.50
Qw =	13.14
w =	
Cw =	4.5
Cu =	7
Do =	1.00
S =	0.00
P =	0.00
R =	0.00
W =	66.18
H =	10.00

Determine the saturation value, Cs

Cs = 14.65-0.41022*T+0.00791*T^2-7.774E-05*T^3

T(C)	Cs
7	12
8	12
9	12
10	11
11	11
12	11
13	10
14	10
15	10
16	10
17	10
18	9
19	9
20	9

Determine U, Qd, and Lo

			Area (A) = w*H, U = Qu/A, Qd = Qw + Qu, Lo = (W/5.38 + Lu*Qu)/Qd										
			A (sq. ft.)	Qu (cfs)	U (f/s)	Qd	Lo						
			5160	76.0	0.01	89.1	7.4						
Determine Do													
Do = Cs-((Cw*Qw + Cu*Qu)/Qd)													
Do(7)	Do(8)	Do(9)	Do(10)	Do(11)	Do(12)	Do(13)	Do(14)	Do(15)	Do(16)	Do(17)	Do(18)	Do(19)	Do(20)
5.5	5.2	4.9	4.6	4.4	4.1	3.9	3.6	3.4	3.2	2.9	2.7	2.5	2.
Determine ka @ various deg C													
ka = 12.9*U^(1/2)/H^(3/2) O'Connor @ 20 deg C (H > 2 ft)													
ka = 21.6*U^0.67/H^1.85 Owens @ 20 deg C (H < 2 ft)													
ka = ka(20)*1.024^(T-20) Correction for various temps.													
ka(7)	ka(8)	ka(9)	ka(10)	ka(11)	ka(12)	ka(13)	ka(14)	ka(15)	ka(16)	ka(17)	ka(18)	ka(19)	ka(20)
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.
Determine kL @ various deg C													
kL = kd = 10.3/sqrt(Qu) @ 20 deg C and Qu < 800 cfs													
kL = kL(20)*1.047^(T-20) Correction for various temps.													
kL(7)	kL(8)	kL(9)	kL(10)	kL(11)	kL(12)	kL(13)	kL(14)	kL(15)	kL(16)	kL(17)	kL(18)	kL(19)	kL(20)
0.68	0.65	0.71	0.75	0.78	0.82	0.86	0.90	0.94	0.98	1.03	1.08	1.13	1.1
Determine ka/kL for various deg C													
ka/kL(7)	ka/kL(8)	ka/kL(9)	ka/kL(10)	ka/kL(11)	ka/kL(12)	ka/kL(13)	ka/kL(14)	ka/kL(15)	ka/kL(16)	ka/kL(17)	ka/kL(18)	ka/kL(19)	ka/kL(20)
0.05	0.06	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.04	0.04	0.04	0.0
Determine ka-kL													
ka-kL(7)	ka-kL(8)	ka-kL(9)	ka-kL(10)	ka-kL(11)	ka-kL(12)	ka-kL(13)	ka-kL(14)	ka-kL(15)	ka-kL(16)	ka-kL(17)	ka-kL(18)	ka-kL(19)	ka-kL(20)
-0.64	-0.61	-0.67	-0.71	-0.74	-0.78	-0.81	-0.85	-0.90	-0.94	-0.98	-1.03	-1.08	-1.1
Determine a = (1-(Do*(ka-kL)/(kL*Lo)))													
a(7)	a(8)	a(9)	a(10)	a(11)	a(12)	a(13)	a(14)	a(15)	a(16)	a(17)	a(18)	a(19)	a(20)

1.71	1.66	1.63	1.59	1.56	1.53	1.50	1.47	1.44	1.41	1.38	1.36	1.33	1.3
Determine travel time to critical deficit for various deg C (days)													
tc = LN((ka/kL)*a)/(ka-kL) Note: If tc < 0, then sag is at discharge point													
tc(7)	tc(8)	tc(9)	tc(10)	tc(11)	tc(12)	tc(13)	tc(14)	tc(15)	tc(16)	tc(17)	tc(18)	tc(19)	tc(20)
3.72	3.83	3.62	3.51	3.41	3.31	3.21	3.11	3.02	2.92	2.83	2.74	2.65	2.5
Determine the maximum DO sag (DO deficit) for various deg C (mg/L)													
Dc = exp(ln(kL*Lo/ka)-kL*tc)													
Dc(7)	Dc(8)	Dc(9)	Dc(10)	Dc(11)	Dc(12)	Dc(13)	Dc(14)	Dc(15)	Dc(16)	Dc(17)	Dc(18)	Dc(19)	Dc(20)
11.01	10.65	10.48	10.26	10.05	9.85	9.66	9.47	9.29	9.12	8.95	8.79	8.64	8.4
Determine the distance to the sag point													
xc = U*tc*16.36 where 16.36 converts units to miles													
xc(7)	xc(8)	xc(9)	xc(10)	xc(11)	xc(12)	xc(13)	xc(14)	xc(15)	xc(16)	xc(17)	xc(18)	xc(19)	xc(20)
0.90	0.92	0.87	0.85	0.82	0.80	0.77	0.75	0.73	0.70	0.68	0.66	0.64	0.6
Determine DO at sag point													
DO = Cu-Dc													
DO(7)	DO(8)	DO(9)	DO(10)	DO(11)	DO(12)	DO(13)	DO(14)	DO(15)	DO(16)	DO(17)	DO(18)	DO(19)	DO(20)
-4.01	-3.65	-3.48	-3.26	-3.05	-2.85	-2.66	-2.47	-2.29	-2.12	-1.95	-1.79	-1.64	-1.4

DO SAG MODEL

This model analyzes dissolved oxygen sag in a river, based on the Streeter-Phelps equation and Water Quality Assessment: A Screening Procedure for Toxic and Conventional Pollutants in Surface and Ground Water - Part I (Revised - 1985) [EPA/600/6-85/002a]

Nomenclature

Variable	Unit	Description
Cu	mg/L	Upstream DO
Cw	mg/L	Effluent DO
D		Dissolved oxygen deficit at point x
Dc	mg/L	Concentration at the sag point
Do	mg/L	Initial oxygen deficit at x=0
e		Natural logarithm, base e
H	ft	Stream depth
ka	L/day	Reaeration constant
kL	L/day	BOD decay coefficient
Lo	mg/L	Ultimate BOD at point x=0
Lu	mg/L	Upstream ultimate BOD
P		Reaeration due to photosynthesis
Qd	cfs	Downstream flow rate
Qu	cfs	Upstream flow rate
Qw	cfs	Effluent design flow rate
R		Oxygen demand due to algal respiration
S		Sediment oxygen demand
t	s	Time when the effluent reaches point x (x/U)
tc	days	Time to reach minimum DO
U	fps	Stream velocity
w	ft	Stream width
W	lbs/day	Effluent ultimate BOD = BOD5/0.68
xc	miles	Distance downstream to sag point

Assumptions

1. Constant cross-sectional area of receiving water
2. Do=1-2 mg/L due to lack of data
3. BOD/DO effects from S, R, and P are negligible
4. Use max. daily BOD5 effluent limit
5. 7Q10 receiving water flows used to determine stream velocity (U).
6. Convert Q in mgd to cfs by Q(cfs) = Q(mgd)*1.55

Insert the following information:		
Facility Name:	Lower Boise w/o Caldwell	
NPDES No:	ID-002150-4	
Lu =		8.50
Qw =		0.00
w =		
Cw =		0.0
Cu =		7
Do =		1.00
S =		0.00
P =		0.00
R =		0.00
W =		0.00
H =		10.00

Determine the saturation value, Cs

Cs = 14.65-0.41022*T+0.00791*T^2-7.774E-05*T^3

T(C)		Cs
7		12
8		12
9		12
10		11
11		11
12		11
13		10
14		10
15		10
16		10
17		10
18		9
19		9
20		9

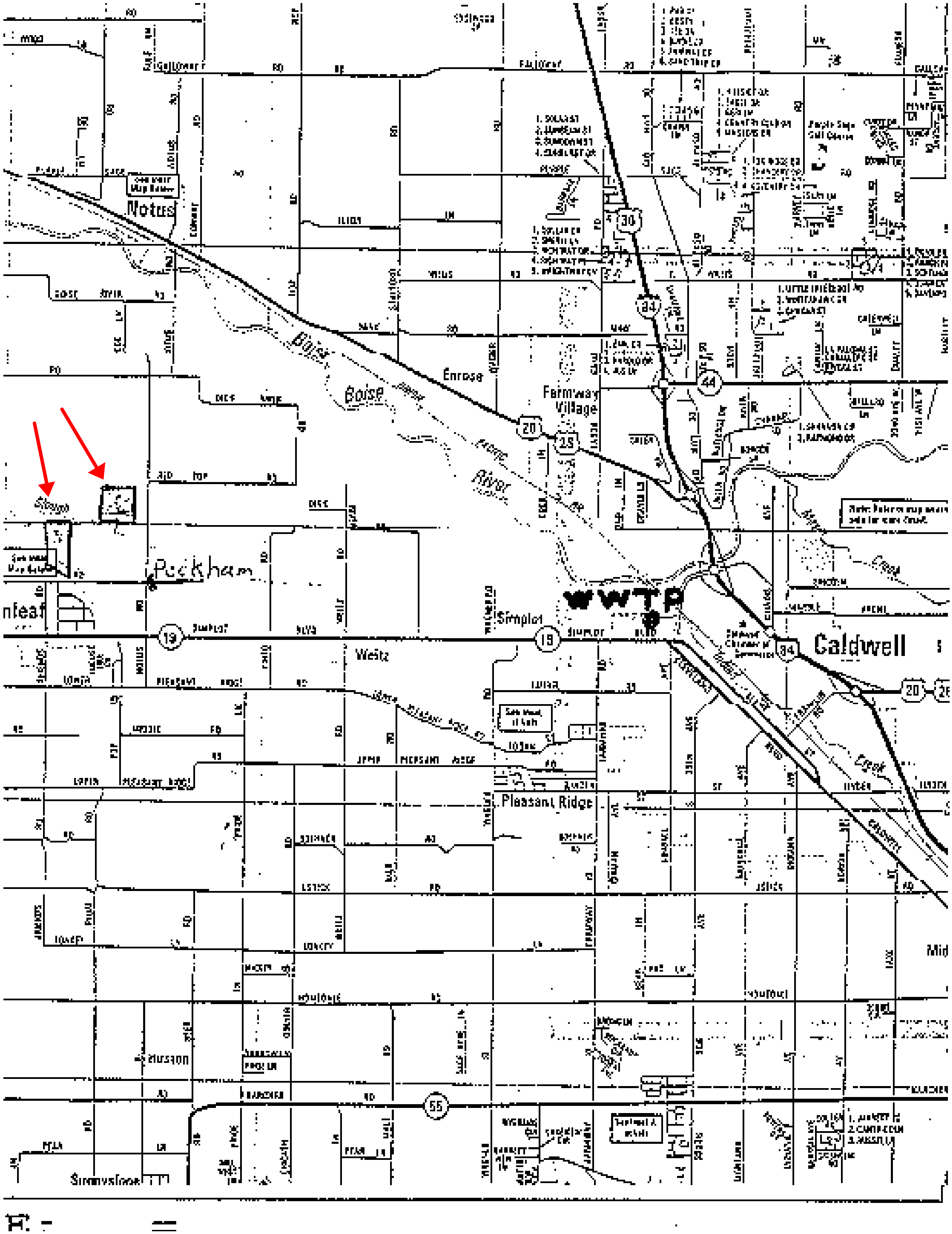
Determine U, Qd, and Lo

Area (A) = w*H, U = Qu/A, Qd = Qw + Qu, Lo = (W/5.38+Lu*Qu)/Qd

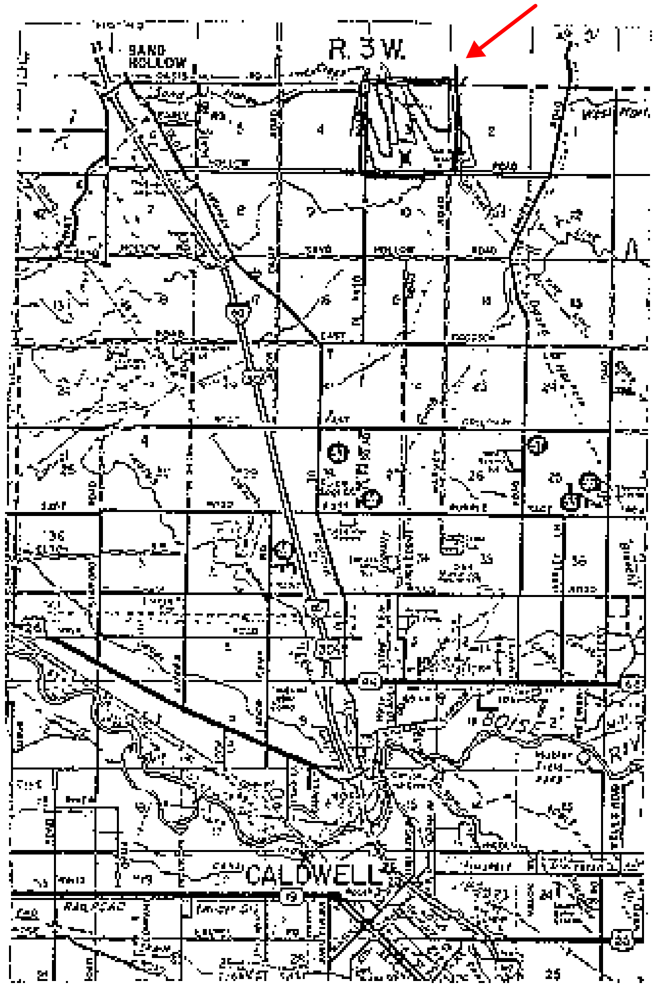
A (sq. ft.)	Qu (cfs)	U (f/s)	Qd	Lo
5160	76.0	0.01	76.0	8.5

Determine Do													
Do = Cs-((Cw*Qw + Cu*Qu)/Qd)													
Do(7)	Do(8)	Do(9)	Do(10)	Do(11)	Do(12)	Do(13)	Do(14)	Do(15)	Do(16)	Do(17)	Do(18)	Do(19)	Do(20)
5.1	4.8	4.5	4.3	4.0	3.7	3.5	3.2	3.0	2.8	2.6	2.4	2.2	2.
Determine ka @ various deg C													
ka = 12.9*U^(1/2)/H^(3/2) O'Connor @ 20 deg C (H > 2 ft)													
ka = 21.6*U^0.67/H^1.85 Owens @ 20 deg C (H < 2 ft)													
ka = ka(20)*1.024^(T-20) Correction for various temps.													
ka(7)	ka(8)	ka(9)	ka(10)	ka(11)	ka(12)	ka(13)	ka(14)	ka(15)	ka(16)	ka(17)	ka(18)	ka(19)	ka(20)
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.
Determine kL @ various deg C													
kL = kd = 10.3/sqrt(Qu) @ 20 deg C and Qu < 800 cfs													
kL = kL(20)*1.047^(T-20) Correction for various temps.													
kL(7)	kL(8)	kL(9)	kL(10)	kL(11)	kL(12)	kL(13)	kL(14)	kL(15)	kL(16)	kL(17)	kL(18)	kL(19)	kL(20)
0.68	0.65	0.71	0.75	0.78	0.82	0.86	0.90	0.94	0.98	1.03	1.08	1.13	1.1
Determine ka/kL for various deg C													
ka/kL(7)	ka/kL(8)	ka/kL(9)	ka/kL(10)	ka/kL(11)	ka/kL(12)	ka/kL(13)	ka/kL(14)	ka/kL(15)	ka/kL(16)	ka/kL(17)	ka/kL(18)	ka/kL(19)	ka/kL(20)
0.05	0.06	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.04	0.04	0.04	0.0
Determine ka-kL													
ka-kL(7)	ka-kL(8)	ka-kL(9)	ka-kL(10)	ka-kL(11)	ka-kL(12)	ka-kL(13)	ka-kL(14)	ka-kL(15)	ka-kL(16)	ka-kL(17)	ka-kL(18)	ka-kL(19)	ka-kL(20)
-0.64	-0.61	-0.67	-0.71	-0.74	-0.78	-0.81	-0.85	-0.90	-0.94	-0.98	-1.03	-1.08	-1.1
Determine a = (1-(Do*(ka-kL)/(kL*Lo)))													
a(7)	a(8)	a(9)	a(10)	a(11)	a(12)	a(13)	a(14)	a(15)	a(16)	a(17)	a(18)	a(19)	a(20)
1.57	1.54	1.51	1.48	1.45	1.42	1.39	1.36	1.34	1.31	1.29	1.27	1.25	1.2
Determine travel time to critical deficit for various deg C (days)													

tc = LN((ka/kL)*a)/(ka-kL) Note: If tc < 0, then sag is at discharge point													
tc(7)	tc(8)	tc(9)	tc(10)	tc(11)	tc(12)	tc(13)	tc(14)	tc(15)	tc(16)	tc(17)	tc(18)	tc(19)	tc(20)
3.84	3.96	3.73	3.62	3.51	3.40	3.30	3.20	3.09	3.00	2.90	2.81	2.71	2.6
Determine the maximum DO sag (DO deficit) for various deg C (mg/L)													
Dc = exp(ln(kL*Lo/ka)-kL*tc)													
Dc(7)	Dc(8)	Dc(9)	Dc(10)	Dc(11)	Dc(12)	Dc(13)	Dc(14)	Dc(15)	Dc(16)	Dc(17)	Dc(18)	Dc(19)	Dc(20)
11.62	11.27	11.10	10.88	10.68	10.48	10.29	10.10	9.93	9.76	9.59	9.44	9.28	9.1
Determine the distance to the sag point													
xc = U*tc*16.36 where 16.36 converts units to miles													
xc(7)	xc(8)	xc(9)	xc(10)	xc(11)	xc(12)	xc(13)	xc(14)	xc(15)	xc(16)	xc(17)	xc(18)	xc(19)	xc(20)
0.93	0.96	0.90	0.87	0.85	0.82	0.79	0.77	0.75	0.72	0.70	0.68	0.65	0.6
Determine DO at sag point													
DO = Cu-Dc													
DO(7)	DO(8)	DO(9)	DO(10)	DO(11)	DO(12)	DO(13)	DO(14)	DO(15)	DO(16)	DO(17)	DO(18)	DO(19)	DO(20)
-4.62	-4.27	-4.10	-3.88	-3.68	-3.48	-3.29	-3.10	-2.93	-2.76	-2.59	-2.44	-2.28	-2.1



Appendix D-1: General Boundary of Land Application Sites



D-2: General Boundary of Land Application Site

APPENDIX E

Site Map